NAVY
PROPOSAL SUBMISSION
INTRODUCTION

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research (ONR). The Navy SBIR Program Manager is Mr. Vincent D. Schaper ((703) 696-8528). The Deputy SBIR Program Manager is Mr. John Williams ((703) 696-0342). If you have any questions, problems following the submission directions, or inquiries of a general nature, contact us. All Phase I proposals must be submitted to:

Office of Naval Research
ATTN: NAVY SBIR PROGRAM, CODE 362
800 North Quincy Street, RM 633
Arlington, VA 22217-5660

The Navy's SBIR program is a mission-oriented program which integrates the needs and requirements of the Navy through R&D topics which have dual-use potential. Navy SBIR topics will also fall within the DoD Science and Technology areas (listed in table 1) and the Navy Science areas. Navy topics will be funded from these areas according to a priority it has established to meet its mission goals and responsibilities. Information pertaining to the Department of Navy mission can be obtained by viewing various Navy World Wide Web sites at http://www.navy.mil. Additional information on the Office of Naval Research (ONR) and Navy SBIR Program can be found on the ONR Home Page (http://www.onr.navy.mil).

NEW THIS YEAR:

1. The Navy is now requiring Appendix E to be submitted in an electronic format along with Appendix A and B.
2. All Phase I award winners must electronically submit a Phase I Summary Report to the Navy at the end of the PhaseI effort. This requirement will also be included in Phase II contracts and is described in further detail below.
3. The Navy requires that all Phase II proposals include an electronically submitted Appendices A, B and E.
4. The dates and requirements for Navy FastTrack submissions have been modified and are described below.

PROPOSAL SUBMISSION CHECKLIST:

All of the following criteria must be met or your proposal will be REJECTED.

1. You must use the electronic format described in the section "Electronic Submission" described below. The Navy will not accept any proposals that do not have electronic forms of Appendix A, B, and E.

2. An electronic version of Appendix E must be submitted with all proposals. Even if you have no Phase II information to report. (Electronic version of Appendix E is a new requirement this year)

3. Your Phase I proposed cost for the base effort can not exceed $70,000. Your Phase I Option proposed cost can not exceed $30,000. The costs for the base and option should be clearly separate and identified on Appendix A, the cost proposal and in the work plan section of the proposal.

4. Your proposal must be received on or before the deadline date. The Navy will not accept late proposals, if you have any questions or problems with submission of your proposal allow yourself time to contact the Navy and get an answer to your question. Do not wait until the last minute.

ELECTRONIC SUBMISSION OF APPENDICES:

There are two ways to submit your SBIR proposal to the Navy, the preferred method is the online submission. The Navy WILL NOT accept the Red Forms in the rear of this book as valid proposal submission forms of the Appendix A, B and E or the Electronic download forms from the DOD Homepage. Instead proposers must use one of the following procedures (but not both). The preferred method is the Online Submission.

1. Online Submission (through the Navy SBIR Website)

A. Go to the ONR Homepage (address -- http://www.onr.navy.mil), click on "Business Opportunities", then click on "Navy SBIR Online submission interface".
B. Submit your Appendix A, B and E via the Online Submission option. Just fill out all the information requested, the screen format will look different then the forms in the solicitation. Once, you have filled in the data, follow the instructions to electronically submit appendices. That is, make sure you click on the Submit button located under the file icon, which will electronically send your appendix to the Navy.
C. After you have received acknowledgment of receipt, print out and sign the Appendix A/B and E form.
D. Submit the signed Appendix A/B and E form along with one original and four copies of your entire proposal (the copies should include 4 copies of the signed Appendix A, B and E forms) to the Navy SBIR Program Office at the above address. Mark the outside of the envelope with your topic number.

2. Diskette submission

A. Obtain the Navy SBIR Appendix A, B and E program (Sbir_ab.exe). This program is available from the Navy SBIR Bulletin Board (through the Internet) or you can request a copy of it on disk from the above address (please specify the computer platform PC or Mac. Note, old Navy Solicitation disk versions do not contain the proper Appendix E form, you must request a new 98.1 Disk or obtain the form from the internet site).
B. To download this program from the Internet: go to the ONR Homepage (address --http://www.onr.navy.mil), click on "Business Opportunities", click on "Navy SBIR/STTR Bulletin Board", click on "Electronic Data Entry Forms". Click on "SBIR" under the heading for "Proposal cover sheets: Appendix A, B and E" or scroll down to the "For Macintosh Users" section for Mac versions.

C. To run the program, double-click on it in File Manager (in Windows 3.1) or Windows Explorer (in Windows '95), or for Mac versions, open it in your spreadsheet application.
D. Data enter information.
E. Save file with .dat extension.(Do not save in a word processing format)
F. Print out and sign the Appendix A, B, and E form.
G. Submit the signed Appendix A, B and E form along with one original and four copies of your entire proposal (including 4 copies of the signed Appendix A, B & E form) together with a disk containing the .dat file generated from the Appendix A, B and E program to the Navy SBIR Program Office at the above address. (Please note we do not want the entire proposal text on disk, just the Appendix A, B and E.) Mark the outside of the envelope with your topic number.

ELECTRONIC SUBMISSION OF PROJECT REPORTS:

The submission of an Electronic Phase I Summary Report will now be required at the end of Phase I. The Phase I Summary Report is a summary of Phase I results, includes potential applications and benefits, and should not exceed 750 words. It should require minimal work from the contractor because most of this information is required in the final report. The summary of the final report will be submitted through the Navy SBIR Webpage at: "http://www.onr.navy.mil/sci_tech/industrial/sbir_bbs/" much like the Online submission of Appendices. If your company does not have access to the Internet on your computer consult your local library or local computer service store.

The Navy is initiating this new program to help increase the awareness and implementation of SBIR funded efforts. The goal is to increase the market potential and transition of SBIR projects by increasing the visibility and ease in accessing information about SBIR projects to DOD, government and DOD industry contacts. This should facilitate the transition of these projects into follow-on efforts and bring additional revenue to the SBIR Company.

To do this the Navy is asking companies to provide information on the status and benefits of their technology developments so that this information can be put into a media that others can easily access and review. The Navy plans to redistribute this information to a wide audience using such tools as the Navy Webpage, Accomplishment Book and a new interactive Navy SBIR Website. This will help provede parties with technical challenges or those with the need to implement new technology, with a user-friendly mechanism to access and identify SBIR companies that can provide them with solutions. This information should be non-proprietary yet detailed enough to provide the interested transition partner with enough knowledge to understand the potential use and benefit to their program.

NAVY FASTTRACK DATES AND REQUIREMENTS:

All Fast Track Applications and required information must be sent to the Navy SBIR Program Manager at the address listed above and to the Contracting Officers Technical Monitor (the Technical Point of Contact (TPOC) for the contract). The following dates and information are required by the company to qualify for the Fast track program. All of the requirements listed in the Fast track Section of the front of this solicitation must be met. The information provided below provides specific dates and some additional information that is required by the Navy SBIR Program Office. The Navy may make further changes to the Fast Track procedures, incorporating the central principles of the Fast Track policy (Section 4.5), subject of the approval of the Under Secretary of Defense for Acquisition and Technology this fall. Please review the Navy Website before submitting your Fast Track application.

Party/Days After Phase I Award Required Deliverables

SBIR Company / 150 Days - Fast Track Application and all supporting information. (See instructions in the DOD section of this Solicitation)
- Phase II 5 Page Summary Proposal, as is required of all Phase I projects as described in Navy SBIR Website, listed above. (It is strongly recommended that if you are contemplating the submittal of a Fast Track Application, you make your intention known to your technical point of contact (TPOC) and the SBIR Systems Command Program Manager (PM) for that respective topic. The PMs are listed on the sixth page of the Navy Introduction.)

SBIR Company /181 - 200 Days - Phase II Proposal
- Phase I Final Report

Navy / 201 - 215 Days Navy will formally Accept or Reject your Phase II proposal.

SBIR Company /45 Days after Acceptance Proof that Funding has been received by SBIR company.

YOUR SUBMISSION TO THE NAVY SBIR PROGRAM:

This solicitation contains a mix of topics. When preparing your proposal keep in mind that Phase I should address the feasibility of the solution to the topic. Be sure that you clearly identify the topic your proposal is addressing. Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees which have been invited to submit a Phase II proposal by the Navy technical point of contact (TPOC) during or at the end of a successful Phase I effort will be eligible to participate for a Phase II award (with the exception of Fast Track Phase II proposals - see Section 4.5). If you have been invited to submit a Phase II proposal to the Navy by the TPOC, obtain a copy of the Phase II instructions from the Navy SBIR Bulletin Board on the Internet or request the instructions from the Navy SBIR Program Office. All Phase I and Phase II proposals should be sent to the Navy SBIR Program Office (at the above address) for proper processing. If the Program Office is unaware of the proposals in the system, they can not be tracked. Phase III efforts should also be reported to the SBIR program office noted above.

The Navy will provide potential awardees the opportunity to reduce the gap between Phases I and II if they provide a $70,000 maximum feasibility Phase I proposal and a fully costed, well defined ($30,000 maximum) Phase I Option to the Phase I. The Navy will not accept Phase I proposals in excess of $70,000 (exclusive of the Phase I option). The technical period of performance for the Phase I should be 6 months and for the Phase I option should be 3 months. The Phase I Option should be the initiation of the next phase of the SBIR project (i.e. initial part of Phase II). The Navy will also offer a "fast track" into Phase II to those companies that successfully obtain third party cash partnership funds ("fast track" is described in Section 4.5 of this solicitation). When you submit a Phase II proposal it should consist of three elements: 1) a $600,000 maximum demonstration phase of the SBIR project (i.e. Phase II); 2) a transition or marketing plan (formally called a "commercialization plan") describing how, to whom and at what stage you will market your technology to the government and private sector; 3) a Phase II Option ($150,000 maximum) which would be a fully costed and well defined section describing a test and evaluation plan for further R&D if the transition plan is evaluated as being successful. You must also submit your Phase II appendix A,B&E electronically to the Navy SBIR Program Office at the address above. While Phase I proposals with the option will adhere to the 25 page limit (section 3.3), Phase II proposals together with the Phase II Option will be limited to 40 pages (unless otherwise directed by the TPOC or contract). The transition plan should be in a separate document.

The Navy will evaluate and select Phase I proposals using scientific review criteria based upon technical merit and other criteria as discussed in this solicitation document. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

TABLE 1. NAVY MISSION CRITICAL SCIENCE AND TECHNOLOGY AREAS

TECHNOLOGY AREAS	SCIENCE AREAS
Aerospace Propulsion and Power	
Atmospheric and Space Science	
Aerospace Vehicles	Biology and Medicine
Battlespace Environment	Chemistry
Chemical and Biological Defense	
Cognitive and Neural	
Clothing, Textiles and Food	Computer Sciences
Command, Control and Communications	
Electronics	

Computers, Software Environmental
Science
Conventional Weapons
Manufacturing Science
Electron Devices Materials
Electronic Warfare Mathematics
Environmental Quality and Civil Engineering
Mechanics
Human-System Interfaces Ocean
Science
Manpower, Personnel and Training Systems
Physics
Manufacturing Technology Terrestrial
Sciences
Materials, Processes and Structures
Medical
Sensors
Surface/Undersurface Vehicles/Ground Vehicles
Modeling and Simulation

NAVY SBIR PROGRAM MANGERS OR POINTS OF CONTACT FOR TOPICS

TOPIC NUMBERS	POINT OF CONTACT/ACTIVITY	PHONE
N98-001 to N98-010	Mr. Douglas Harry (ONR)	703-696-4286
N98-011 to N98-018	Mr. Joe Johnson (MARCOR)	703-784-4801
N98-019 to N98-066	Ms. Carol VanWyk (NAVAIR)	301-342-0215
N98-067 to N98-128	Mr. William Degentesh (NAVSEA)	703-602-3005

NAVY SBIR 98.1 SOLICITATION
WORD/PHRASE INDEX

WORD TOPIC No.

DEPARTMENT OF NAVY
SMALL BUSINESS INNOVATION RESEARCH (SBIR) PROGRAM
SOLICITATION 98.1 TITLE INDEX

OFFICE OF NAVAL RESEARCH

MARINE CORPS

NAVAL AIR SYSTEMS COMMAND

N98-022 Innovative UAV VTOL Drive Technology
N98-023 Innovative Technology to Enhance Aircraft Software Configuration Control
N98-024 Ceramic To Metal Joining
N98-025 Thermoset Resin Development for In Situ Fiber Placement
N98-026 Biofidelic Lumbar Spine for Human Response to Aircraft Ejection and Helicopter Crash
N98-027 Phase Change Material (PCM) Enhanced Man-Mounted Liquid Active Microclimate Cooling System
N98-028 Development Of Fault Tolerance Analysis Tools For Flight Critical Avionics Systems
N98-029 Automatic Derivation of Traditional Anthropometric Measurements From Whole Body Scan Data
N98-030 Application Of Advanced COTS Architectures To Airborne Signal Processing and computing
N98-031 Marine Mammal Detection for Environmental Compliance
N98-032 Frequency Selective filter/Switch
N98-033 Magnetic Anomaly Detection (MAD) Geomagnetic Reference Sensor
N98-034 Multisensor Image Positioning System for Tactical Level Targeting
N98-035 Signal Processing and System Concepts to Exploit Passive Signals in Airborne Active ASW Missions
N98-036 Light-Weight Airborne Repeater for Tactical Radio Networks
N98-037 Optical Phased Array Sensor and Processor Development

N98-038 Low-latency, Protocol Independent, Network Interfaces for Advanced Avionics Systems
N98-039 Pulse Detection Electronic Hardware for Multi-discriminant Laser Radar
N98-040 Weapon System Operator Tactical Operation Aids
N98-041 Low Cost, Light Weight Optics For Improved Multi-Function EO Sensor Performance
N98-042 Environmentally Adaptable Detector/Classifier
N98-043 Advanced SAR Techniques Including UWB/UHF for Mine and Unexploded Ordnance Detection/Classification
N98-044 Innovative signal detection for impulsive-source active sonar systems operating in shallow water
N98-045 Low Cost Adaptive Optics for Commercial and Military Systems
N98-046 Embarked Aircraft Tracking System (EATS)
N98-047 Passive Target Velocity Measurement System
N98-048 High Bandwidth, Secure, Portable, Wireless LAN
N98-049 Portable Ground Based Solid State IFF Situation Display System
N98-050 Corrosion Avoidance Materials
N98-051 Electronic Schematic Archive
N98-052 Non-Cadmium Brush Touch-up Process for Cadmium Replacements (IVD Aluminum, Zinc Alloys, Molten Salt) Repairs
N98-053 Develop Automatic Test System (ATS) Analysis and Configuration Management Tool
N98-054 A Tool for Forecasting Training Requirements by Simulation
N98-055 Computer-based Training Conversion System
N98-056 Helicopter Weapon System Emulation Model
N98-057 Advanced Training Technology Delivery System

N98-058 Imagery Database Retrieval and Indexing
N98-059 Interactive Part-Task Training Over Local Area Networks (LANs) and the Internet
N98-060 New Techniques for Compiling Multiresolution Terrain Representations
N98-061 Real-time High Fidelity Image Synthesis for Virtual Reality-Based Trainers
N98-062 Aluminum Nitride Infrared Window
N98-063 Durable, Transparent, Electrically-Conductive Coatings
N98-064 Low-Cost, High-Fidelity, Portable UCAV Simulation
N98-065 Accelerometer-Based Multi-Sensor INS
N98-066 Shape Charge Warhead Effectiveness Simulation, Including the Resultant Effects when Coupled with Current Shaped Charge Countermeasures.

NAVAL SEA SYSTEMS COMMAND

N98-067 Wideband Fine Frequency Measurement
N98-068 Real Time Software Upload/Download via Satellite
N98-069 Low-Cost Nozzle Throat for High-Performance Tactical Missiles
N98-070 Active Antenna Design Concept Using Microwave Power Modules
N98-071 Robust Adaptive Target State Estimation for Missile Guidance
N98-072 Combat System Software Migration to Open Systems
N98-073 Low-Cost, Non-Rayon Carbon-"Phenolic" Composites for Rocket Nozzle Applications
N98-074 Development of low-cost X-band T/R modules with commercial off-the-shelf components.
N98-075 Low Cost Manufacturing of Lightweight Resin-Matrix Composites
N98-076 Improvements in Microwave Power Modules
N98-077 A Multi-Level Network (MLN) Approach to Theater Battle Management Operations
N98-078 Compact High Energy Infrared Laser
N98-079 PCMCIA Card to Collect/Store Vibration/Performance Data for Operating Machinery.
N98-080 Hover-Craft (LCAC) Vehicle Dynamics
N98-081 Variable Virtual Combat Mock-up (VVCM)
N98-082 Reconfigurable Computing

N98-083 Non-intrusive, non-mounting, non-contacting hand held Vibration Data collector, storage and analysis system for Operating Machinery
N98-084 Development of a Registration Mine Capability
N98-085 Virtual Integrated Engineeering Data Extraction Environment
N98-086 Cleaners for Wastewater Ultrafiltration Membranes
N98-087 Modulated Scattering Technique (MST) Field Probe Array System (FPAS) for Rapid Near-Field Measurements of Antennas and Composite Walls
N98-088 Co-Infusion of Multiple Resin Systems Through the Thickness for Composites Structures with Enhanced Fire Performance
N98-089 Development of a Low Cost Process to Provide Improved Carbon Fiber-Vinyl Ester Adhesion
N98-090 Automated Mechanism for Transfer of Unclassified Information Residing in Secret Environments into

Unclassified Environments Using Intermediate, Multi-Level Databases
N98-091 Quieting inflow to enclosed impellers and/or open field propellers for acoustic silencing
N98-092 Shipboard Airborne Noise Control Design and Diagnostic Tool
N98-093 Biofouling and Biocorrosion Monitor
N98-094 Affordable High Performance Reinforced Polyurethane Shock and Vibration Mounts
N98-095 Red Phosphorous Powder Manufacturing Process
N98-096 Non-skid Surface Coatings for Navy Fleet Applications
N98-097 Fiber Optic Link Simulator
N98-098 Injection Molded Ceramic Ferrules for Fiber Optic Connectors
N98-099 Dynamic Firing Zone for Weapon Systems
N98-100 Self-Routing in Photonic Packet Switching
N98-101 Corrosion Prevention and Control for Out Board Submarine System
N98-102 Monopropellant Fuels
N98-103 Universal Acoustic Sensors for Acoustic Sonar Arrays
N98-104 Embedded Intelligent Tutoring Systems
N98-105 Tunable Vibration Absorber for Small, Underwater Vehicles
N98-106 Acoustic Interference Rejection
N98-107 SC 21 Smart Product Model (SPM)
N98-108 Grabber for Ordnance Handling Robot
N98-109 Control Approach for Heavy Payload Handling Robots
N98-110 Rugged, Portable Ground Station for NSFS Targeting
N98-111 NAVARM Naval Range Extender for Army Artillery Shells
N98-112 Small, Rugged Internal Combustion Engine
N98-113 Robotics - Develop Manipulators To Handle Various Types of Manufacturing Processes
N98-114 Advanced Technologies Leading to Condition Based Maintenance
N98-115 COTS Approach to Information Security
N98-116 Compact Sensor for Measuring Large Strains on the Surface of Elastomers
N98-117 Combat System Testing & System Integrity Assessment Tools
N98-118 Plasma Antenna For Type 18 Periscope
N98-119 Use of Common Object Request Broker Architecture (CORBA) to Control Classified Data Distribution
N98-120 Plug and Play Adjunct Processing To Support Rapid Technology Insertion
N98-121 High Power Switching for MF Active Sonar Aperture Selection
N98-122 Low Cost COTS Replacement for Versa Module Europe (VME) Chassis Computing Systems
N98-123 Low Cost Hydrophone Manufacturing & Assembly
N98-124 Sonar Performance Enhancement in the Littoral Environment
N98-125 Optimized Laser Scanning Doppler Vibrometer for Measurements on Rotating Propellers in Water
N98-126 Combat Systems COTS System Administration
N98-137 Next Generation Combat System Display Concepts
N98-128 Migration of Advanced Development and COTS Applications to Tactical Operating Environments

DEPARTMENT OF THE NAVY
98.1 SBIR SOLICITATION TOPICS

OFFICE OF NAVAL RESEARCH

N98-001 TITLE: Technology for Affordability

OBJECTIVE: The objective of this project is to develop innovative technologies that will reduce the costs of manufacturing and or repair/remanufacturing aircraft, rotorcraft, ships, submarines, weapon systems or components. These methods or processes will reduce the life-cycle costs of the system, but not adversely impact performance. Areas of interest include but are not limited to materials, electronics, metalworking, composites, joining, and eletro-optics.

DESCRIPTION: There is a need to improve the affordability of new Navy weapon systems and develop cost effective methods to sustain existing and aging Navy weapon systems. Affordability has become a major consideration in all aspects of the life-cycle of Navy systems. Technologies that will allow the Navy to economically acquire new weapon systems and maintain these systems in operation and provide for the upgrade of these systems with modern technologies will make life-cycle costs more affordable. At the present time the manufacturing and engineering sectors of the country have been slow to transition new developments into production. Proposals are sought that will transition these developments so they will provide benefit to the Navy and commercial industry. Efforts that have impact above the factory floor are also of interest i.e. supply chain integration, lean/agile practices design, six sigma manufacturing, integrated product and process development, manufacturing processes/fabrication maturation, and advanced industrial practices (e.g., benchmarking and best practices--technical and business, etc.) Proposals should specifically describe the technology, how it will be developed, its estimated benefits and how it would be transitioned. A minimum of three Phase I awards will be made.
PHASE I: Identify improvements to be developed, and detail where and why they will be effective.
PHASE II: Choose one of those improvements, develop a working model/prototype, and demonstrate its performance characteristics. Develop a commercialization (Phase III) plan, including descriptions of specific tests, evaluations and implementations to be performed.
PHASE III: Implement the Phase III plan developed in the second Phase.

COMMERCIAL POTENTIAL: Private sector applications and benefits must be inherent in the objective of the proposed effort.

REFERENCES:
1. The Navy ManTech Homepage is at "
http://www.onr.navy.mil/sci_tech/industrial/#mantech"

KEY WORDS: Affordability; maintainability; manufacturing;

six sigma manufacturing; integrated process and product development; processes; benchmarking; and best practices.

N98-002 TITLE: Advanced Comprehensive Distributed Simulation Support for Battlespace Environment

OBJECTIVE: Develop innovative Modeling and Simulation (M&S) technology for managing the full life cycle of distributed interactive simulations.

DESCRIPTION: The Modeling and Simulation (M&S) community has adopted the High-Level Architecture (HLA) as a standard to provide the infrastructure to support distributed simulation. While the HLA provides the mechanisms for interoperability, higher level coordination capability is needed for activities involved in the creation, execution, and management of distributed simulations. For example, to build and execute a simulation, it is necessary to browse existing simulation assets, integrate them into a scenario development environment, construct an exercise, initialize simulation parameters, and then commence, monitor, and manage the distributed simulation. This effort will innovate advanced technology to develop an Integrated Battlespace Environment M&S coordination manager.

PHASE I: Develop an architecture for a prototype system. Investigate existing military simulation resources as participants in a prototype system. Develop the prototype system to integrate assets into a scenario development environment, construct an exercise, initialize the participants and perform basic simulation management for the exercise operating in the context of the HLA.

PHASE II: Enhance prototype into an initial operational system that includes additional elements of HLA Run-Time Infrastructure (RTI) services. The additional services will provide more control for initialization and management of multiple distributed simulation participants. The initial system should support integration of joint simulation assets from different branches of the military.

PHASE III: Integrate, apply and transition prototype into a large scale Modeling & Simulation and training programs.

COMMERCIAL POTENTIAL: There is significant opportunity for dual use applications in the M&S area. Typical M&S technologies include 3D visualization of simulations, and distributed communications and networking. The tools, prototypes, and research developed under this topic will be applicable to the commercial sector in areas of planning and scheduling, networked gaming, medical visualization and training, and other scientific simulation (such telephony).

REFERENCES:
1. Department of Defense; High Level Architecture Object Modeling Template Version 0.3 Defense, Modeling and Simulation Office. Alexandria, VA. May 1996
2. Department of Defense; High Level Interface Specification (Version 0.4) Defense, Modeling and Simulation Office, Alexandria, VA.

KEY WORDS: Modeling, Simulation, M&S, High Level

Architecture, HLA

N98-003 TITLE: Advanced High Pulse Repetition Frequency Radar Modulator

OBJECTIVE: Design and build a radar power supply/mod-anode-pulsed modulator capable of switching a 20 Kilovolts modulating anode at a Pulse Repetition Frequency (PRF) of 100 KHzor higher.

DESCRIPTION: High power millimeter wave RF amplifiers such as gyroklystrons are capable of producing kilowatts of peak power, even at millimeter-wave frequencies. Present development efforts of high average power versions of gyroklystron amplifiers should deliver 80 kW peak and 10 kW average power at W-band frequencies. At the present time, gyroklystrons under development utilize modulating anodes for beam control; these mod-anodes generally require high modulating voltages (e.g. from -2 kV to up to +20 kV relative to the cathode potential, which is generally -50 to -65 kV). Though such tubes can in principal support high Pulse Repetition Frequencies (PRF's), the maximum PRF of the system is usually limited by the modulator, which must switch tens of kilovolts at the PRF rate. Current modulator technology can only achieve switching rates of approximately 10 KHz at these high voltage levels. In addition, demanding requirements on phase noise require tight regulation on both mod-anode voltage and cathode voltage (typically only a few volts RMS ripple or better) in order to meet radar requirements. These challenges are formidable. However, recent advances in high power solid state switches such as Insulated-Gate Bipolar Transistors (IGBT's) and all-solid-state magnetic switches make possible new modulator topologies which can produce switching rates exceeding 100 Khz. Additionally, advances in tetrode based modulator technology make possible high PRF non-solid-state modulators. This task will involve designing and building a high PRF (100 KHz or greater) modulator for use in the 10 kW average power gyroklystron-based radar being developed by the Naval Research Laboratory. The Naval Surface Warfare Center Dahlgren Division has interest in high PRF gyroklystron-based radar for ship self-defense applications.
PHASE I: Design a modulator, including power supply, capable of switching the control voltage of NRL's gyroklystron amplifier at a PRF of 100 KHz or greater. The best design will be able to switch the required control voltage at the highest rate. NRL personnel will be consulted during the design process to ensure that the final design is fully compatible with the gyroklystron.
PHASE II: Build the modulator and power supply designed in Phase I and perform testing to verify that the modulator meets the design objectives. Additionally, determine the maximum PRF rate of the modulator through testing.
PHASE III: Develop vacuum electronic-based radar system application(s).

COMMERCIAL POTENTIAL: This modulator would be useful in applications where large voltages must be switched at speeds exceeding 10 KHz, such as a modulator for medical Linear Accelerators (LINACS) used in X-Ray machines for cancer therapy. Other possible commercial applications include materials processing and civilian radars.

REFERENCES:
1. "High-Power Microwave-Tube Transmitters," William North, Los Alamos NL,Report LA-12687-MS, 1994, US DOE Off. Scientific and Technical Information.(Distribution of this report restricted to U.S. only).
2. "High Power Microwave Sources," Granatstein and Alexeff (Artech House),and the papers in IEEE Trans. on Plasma Science, Vol. 24, No. 3, June 1996 special issue on high power microwave generation.

KEY WORDS: High-Power Modulators; Gyroklystrons; Insulated-Gate Bipolar Transistors (IGBTs); Radar; High Pulse Repetition Frequencies (PRFs); tetrode

N98-004 TITLE: Acousto-optic (AO) Near Infrared Beam Deflector

OBJECTIVE: To develop a two-dimensional (2D) near infrared (IR) beam deflector with wide input angular bandwidth at 1550 nanometers (nm), preferrably, for an automatic target/image recognition (ATR) or a phased array antenna (PAA) system.
DESCRIPTION: Most of the current AO beam deflectors use visible light, and are also limited to parallel light beam input. This 2D deflector must be capable of scanning beam up to 10 degrees off the undiffracted beam. It must handle a large angular input beam width of plus or minus 5 degrees, which is above the present technology. It also has a large time-bandwidth product (>1000), large rf bandwidth (35 - 65 MHz), and the associated optical aperture size (10mm x 25mm) with from 20% to 30% diffraction efficiency at 1550 nm. This kind of 2D beam deflector combined with other optical elements will be used as a image processor with a few microseconds response time. Applications include image scanning, image processing, and automatic target/image recognition for an ATR system, a periscope system, and the next generation phased array antenna system. Compact configuration is preferable.
PHASE I: The improved concept of 2D AO beam deflector and proof of device performance are required, including a small scale demonstration of the device.
PHASE II: Develop, fabricate, and test a full-scale device satisfying the specifications above for the potential system applications determined by Phase I. System applications will be in ATR and/or PAA systems.
PHASE III: Show system potential toward specific systems such as an ATR and/or a PAA system.

COMMERCIAL POTENTIAL: ATR and PAA systems pertain to production line inspection and fast light scanning applications.

REFERENCES: "Acousto-Optic Devices", Z. Xu, John Wiley & Sons, 1992

KEY WORDS: Acousto-optic, Beam Deflection, Spectrometer, Wavelength Division Demultiplexing, Phased Array Antenna, Fiber Optical Communication

N98-005 TITLE: Long Life, Primary, Fused Salt Batteries for Pulse Power Applications

OBJECTIVE: Advance the performance of fused salt batteries in A-size systems requiring very high power pulses for at least four hours.

DESCRIPTION: The lithium/sulfur dioxide (Li/SO2) battery is the Navy's workhorse power supply for sonobuoys. Employed in antisubmarine warfare (ASW), sonobuoys are generally A-size, meaning roughly 38 inches long and 4 7/8 inches in diameter, and air deployed. The battery must occupy a minimum weight and volume. For such use, Li/SO2 offers the best presently available combination of high power and energy at affordable cost. However, changes in the ASW arena, have driven an exponential increase in pulse power for future sonobuoys while retaining the need for low weight and volume and at least a four hour operating life. Recent developments in thermal batteries have provided 4.2 kW, for 200 seconds over two hours of operation in a battery weighing 13 pounds and occupying 10 inches of the sonobuoy length. Further developments in fused salt batteries can provide a minimum power of 4.6 kW at a min mum of 50 V, for 150 - 200 seconds, with an operating life of at least four hours. Such a battery could weigh 10 pounds and occupy 8 inches of sonobuoy length, or less. This level of performance will require component optimization such as: long life separators, ultra high performance insulation, bipolar stack edge seals, etc. These combined advances would spin-off enhanced ASW performance for countermeasures and A-sized targets, as well as numerous weapons, missiles, and munitions.

PHASE I: Design a fused salt battery for future sonobuoys. Evaluate pulse power, number of pulses, and operating life, relative to physical size and weight (including all ancillary components) of the battery. These include all additions to the battery to ensure safe operations in the buoy, or the deployment platform, and in storage. Demonstrate on a small scale, such as single cells.

PHASE II: One or more specifications will be provided for a high performance battery. Batteries will be demonstrated in bench top testing.

PHASE III: Further development of battery technology for an advanced sonobuoy and for quiet electric and/or hybrid electric vehicles for forward military deployment (Humvee, Swimmer Delivery Vehicle, Unmanned Vehicles-Air, Ground, Water Surface, and Underwater).

COMMERCIAL POTENTIAL: The development of this technology as a primary (non-rechargeable) battery is a natural foundation for the increased complexity inherent in rechargeable batteries. This foundation will logically lead to rechargeable batteries for electric and hybrid electric vehicles for civilian use (e.g., lawn mowers, mopeds, cars, and buses).

REFERENCES:

1. Handbook of Batteries and Fuel Cells, D. Linden, ed., McGraw-Hill, New York, 1984.

2. "Design and Performance of High-Power Long-Life Thermal Batteries," N. Papadakis et al, 37th Power Sources Conference, Cherry Hill, NJ, 1996
3. "Sonobuoy Battery Development," P.B. Keller et al, 37th Power Sources Conference, Cherry Hill, NJ, 1996

KEY WORDS: Thermal Battery, Molten Salt Battery, Fused Salt Battery, Sonobuoy

N98-006 TITLE: Waterproofed MEMS-Based Conformal Shear Stress Sensors

OBJECTIVE: Develop a thin, flexible, waterproofed, MEMS-based shear stress sensor for use on small and large-scale Navy vehicles in a freshwater environment.

DESCRIPTION: An array of waterproof and flexible MEMS based shear stress sensors would greatly enhance our evaluation of flow characteristics about model hulls and control surfaces. If the transition, separation, and turbulence characteristics are known, they can assist in evaluating the hydrodynamic merit of a new design and, perhaps more critically, in validating computational fluid dynamics (CFD) methods. A thin and flexible MEMS based sensor could provide high resolution, and extremely sensitive shear stress data about curved surfaces. Such devices could be installed flush mounted without milling matching sensor cavities or pits. The devices must survive total freshwater submersion for about 8 weeks and withstand total pressures of about 2 atm. Ideally, an array of such sensors could be packaged for easy mounting and re-use about a model or control surface. Ultimately the system should be deployable for longer periods in salt water. No access to classified information is required by the contractor.
PHASE I: First, conduct analysis of projected MEMS performance to verify that the application is viable in principle. Demonstrate proof-of-concept for waterproofing techniques on a MEMS sensor and validate the capabilities of a flexible MEMS shear stress sensor.
PHASE II: Deliver a satisfactory waterproofed flexible shear stress sensor with 2-D capabilities (direction and magnitude) and install an working array of sensors on a Navy radio-controlled submarine model (RCM) at the Naval Surface Warfare Center Carderock Division (Bethesda, MD).
PHASE III: Validate the sensor array and increase the robustness of the packaging techniques for a variety of platforms.

COMMERCIAL POTENTIAL: Industries which will benefit include aerospace, automotive, chemical and manufacturing groups who perform critical flow evaluations and monitoring.

REFERENCES:
1. Jiang, F., Y.-C. Tai, K. Walsh, T. Tsao, G.-B. Lee, and C.-M. Ho, A Flexible MEMS Technology and its first application to shear stress sensor skin.
2. Jiang, F., Y.-C. Tai, B. Gupta, R. Goodman, S. Tung, J.-

B. Huang, C.-M. Ho, A Surfaced-Micromachined Shear stress imager.
3. C.-M. Ho, S. Tung, G.-B. Lee, Y.-C. Tai, F. Jiang, and T. Tsao, MEMS - A Technology for Advancements in Aerospace Engineering, AIAA 97-0545, January 1997.

KEY WORDS: MEMS; shear stress measurements; miniature shear stress sensors; waterproof; flexible

N98-007 TITLE: A Polymeric Hose Health Assessment Device

OBJECTIVE: Develop a device for quickly and economically assessing the remaining life or health of a polymeric hose in place.

DESCRIPTION: Polymeric hoses used in hydraulic systems, cooling water routing, and myriad other high and low pressure applications are common on Navy ships and aircraft, but there is currently no reliable way to assess their health. A simple, quick, and inexpensive method for nondestructive testing of hose integrity is needed as a maintenance tool. The device should be able to detect impending fractures, development of thinned regions, and similar hose flaws, and provide a "red light/green light" datum for replacement or continued service. The device should be portable, hand operated, and small enough to concentrate the inspection in the areas near attachment points where hoses typically fail. Computerized systems, systems requiring extensive data analyses to make a replacement decision, or use of complex scanning systems are all undesirable for their size and/or potential operator training requirements. The target operator is a Navy E-3 or E-4 in the engineering rates.
PHASE I: Determine the basic physics of nondestructive detection of flaws in polymeric hose materials. Demonstrate the feasibility of converting this technology into a simple, hand held hose inspection device.

PHASE II: Develop a working prototype hose health assessment device. Conduct laboratory scale tests on a variety of hose materials and sizes with known flaws in various locations. Evaluate device performance in terms of overall success in detecting different types of flaws (i.e., thin spots, impending fracture areas, etc.). Establish database relating flaw detection success rate to type of flaw and hose parameters.
PHASE III: Under program office or industry sponsorship, conduct tests on a variety of hose types and uses within the fleet. Testing should be carried out on ships, submarines, and aircraft to demonstrate detection rate in field environments. Device performance on selected commercial systems will be demonstrated.

COMMERCIAL POTENTIAL: A hand-held hose health device with proven performance capability will have immediate application commercially. The aircraft industry will benefit in time and cost savings, as well as increased passenger safety. Another application will be the automotive repair industry, where health of radiator, powersteering, brake-line hoses can be quickly determined. Other applications will also be identified if the device can be supplied at reasonable cost.

REFERENCES:
1. Favro, L. D., Kuo, P. K., Thomas, R. L., "Thermal Wave Imaging of Composites and Polymers," Proceedings, Society of Photo-Optical Instrumentation Engineer Conference, April 1994.
2. Haddad, Y. M., Molina, G., "An Acousto-Ultrasonic Pattern Recognition Approach for the Characterization of the Mechanical Response of Engineering Materials," Proceedings, American Society of Mechanical Engineers and American Petroleum Institute, Energy Week Conference, January 1996
3. Eighth (and prior) "Symposium of Nondestructive Characterization of Materials," Hosted by Johns Hopkins University Center for NDE, in Boulder Colorado, June 15-20, 1997.

KEY WORDS: hose health, hose inspection, hose integrity

N98-008 TITLE: Low Velocity Initiation Ram Accelerator Concepts

OBJECTIVE: To develop and demonstrate concepts techniques to reduce the starting Mach number associated with Ram Accelerator guns.

DESCRIPTION: Ram accelerator guns have been shown to have the potential to propel projectiles to speeds in excess of 3 km/sec. However practical use of such guns as weapons deployed on Navy ships requires that gun barrel length be constrained to practical length, typically 70 calibers or less. In a Ram accelerator, propellant gases are loaded into the gun tube. The projectile is designed so that as a result of its shape, the void between the projectile outer walls and the gun tube forms a naturally moving inlet to the propellant gases. Shock heating and compression ignites the propellant gases, which then produce thrust. Starting of this inlet, generally requires inlet entrance Mach numbers of approximately Mach 3. As a result, an alternative high acceleration mechanism is needed to boost the projectile to the inlet start speed. Current Ram accelerator efforts in the Navy utilize a hybrid combination of solid propellant gun and launch tube combined with Ram accelerator barrel extension. Reduction of the Ram starting mach number is desired to minimize total barrel length.

PHASE I: The phase 1 effort will conduct surveys and analysis of innovative concepts to be demonstrated in phase 2. Approaches to reducing the starting mach number include: use of alternative gas mixtures, innovative gas injection techniques, alternative inlet and combustion initiation mechanisms. The contractor will analyze implications of methods to practical design of navy projectiles.

PHASE II: The contractor will demonstrate low velocity start with shots of small scale projectiles. These shots will demonstrate initiation of thermally choked propulsion mode.

PHASE III: In Phase III, the contractor will very performance by detailed design and fabrication of the projectile and will demonstrate performance through firing of a full scale projectile.

COMMERCIAL POTENTIAL: Hypervelocity light gas guns such as the Ram accelerator have potential to deliver commercial payloads into low earth orbit at costs that are a fraction of conventional rocket propulsion.

REFERENCES:
1. D. Kruczynski, F. Liberatore and M. Nusca; An Analysis of Ram Acceleration for Specific Naval Applications, ARL-TR-1073, April 1996
2. Hertzberg, A., Bruckner, A.P. and Bogdanoff, D.W., Ram Accelerator: A New Chemical Method for Accelerating Projectiles to Ultrahigh Velocities, AIAA Journal, Vol 26, 1988, pp195-203.
3. Tidman, D. A.,and Massey, D.W.; Electrothermal Light Gas Gun, IEEE Trans. Mag. Vol 29, pp. 621-624, Jan 1993.

KEY WORDS: Ram accelerator, gas generator, light gas gun

N98-009 TITLE: High-Rate Single-Event Combustion Diagnostics in Electromagnetic Interference Environments

OBJECTIVE: Develop non-invasive diagnostic instrumentation for measurement of time-dependent temperatures in single-event tests of combustible materials impacting metal targets at high speed, in the presence of high transient electromagnetic fields.

DESCRIPTION: The Navy is evaluating the rapid production of heat and gases from non-explosive sources via rapid combustion of powder materials. One method of ignition is by high speed impact of materials onto target plate configurations. In impact tests, the speed, orientation, and condition of the impacting material, as well as the post-ignition motion of metal parts can be monitored by flash radiography. The significant electromagnetic interference from the flash radiography equipment can cause disruption or loss of data from conventional low-level signal sources such as thermocouples or multiwavelength infrared detector systems. The need for rapid thermal response can dictate the use of fragile exposed thermocouple junctions that may not survive damage during the test, thereby providing only partial recording of the time-dependent temperature. There is a need for a robust, non-invasive system for measurement and recording of single-event (non-repetitive) time-dependent high temperatures over periods of microseconds to several hundred milliseconds, with measurements on the order of every microsecond or more frequent. The system would be able to function in either laboratory test chamber or outdoor field test conditions, in concert with flash x-ray diagnostics. The region of the expanding fireball to be diagnosed could be limited by the walls of a container to be approximately one foot on a side, or, in a field test, could be on the order of ten feet on a side. The system would sample a selected region of the fireball.
PHASE I: Design and develop temperature-calibrated laboratory system and demonstrate feasibility of operation in high electromagnetic noise environment.

PHASE II: Based on Phase I work, design and fabricate field test system and validate performance through transient temperature diagnoses of a series of actual combustion event field tests conducted at a selected U. S. Government test facility. Any equipment developed on this project will be the property of the U. S. Government.
PHASE III: This system or similar systems would be used in support of testing for an Advanced Technology Demonstration project scheduled to begin in FY99.

COMMERCIAL POTENTIAL: This system would find application to the diagnoses and control of electric welding processes, and to the design and diagnoses of vehicle air bags and aerospace rockets.

KEY WORDS: combustion, electromagnetic interference, missile defense, ship self defense, non-intrusive diagnostics

N98-010 TITLE: Innovative Air Inlet and Nozzle Expansion Concepts for Missiles

OBJECTIVE: To develop and validate lightweight effective inlet and nozzle concepts applicable to supersonic cruise missiles with air breathing propulsion.

DESCRIPTION: The next generation of cruise missiles may be configured without wings and other large aerodynamic surfaces in order to minimize drag, resulting in a non-axisymmetric shape. Air intakes must be well integrated with the geometry in order to achieve the required flow parameters at the engine entrance, and the requisite nozzle system must accelerate the turbojet combustor flow to match local free-stream pressure over a wide range of flight conditions without resorting in complex, heavy, variable geometry. Significant boundary layer bleed must be pioneered. An air induction system must be capable of efficiently compressing air flows at all speeds up to Mach 6. Since the preferred vehicle shape minimizes aerodynamic-control surfaces, a high degree of thrust is desired but not essential, and improved transonic acceleration of a turbojet-powered missile is of interest.
PHASE I: Feasibility studies will be conducted. Specific concepts must be identified, and details of where and why they will be effective must be provided.
PHASE II: Further analyses will be conducted and a working model/prototype will be developed. CFD-type analyses and experimental tests will be conducted, and technical plans for follow-on efforts will be developed.
PHASE III: Tests will be coordinated with related programs and Advanced Technology Demonstrations, as required.

COMMERCIAL POTENTIAL: Innovative air inlet and nozzle concepts have a world-wide market for civil and military aircraft, especially if they apply to subsonic aircraft.

KEY WORDS: Supersonic inlets, transonic accelerations, cruise missiles

MARINE CORPS

N98-011 TITLE: Lightweight Track Components for Amphibious Vehicles

OBJECTIVE: To provide high strength, low weight track and road wheel components for use in the Marine Corps' Advanced Amphibious Assault Vehicle (AAAV).

DESCRIPTION: The AAAV is the Marine Corps' next generation amphibious assault vehicle and is capable of over-the-water transit at speeds in excess of 20 knots while maintaining full land mobility. Because of this high water speed requirement, the vehicle is extremely weight sensitive and all efforts are being undertaken to reduce component and system weights. The track is a prime candidate for weight reduction efforts as it exacts an unacceptably high weight penalty on the vehicle due to the extreme conditions under which it must operate. This effort will provide the AAAV with a lightweight track system which will be impervious to corrosion, be durable, and transmit a low aural signature.
PHASE I: Perform design studies and generate conceptual designs for a lightweight, durable, corrosion resistant track system for the AAAV. Alternate materials choices are to be explored. Design information from the AAAV prime contractor will be provided to assist in the design studies. The winning contractor must demonstrate that he possesses specific knowledge on track laying vehicles and is aware of and will not duplicate previous track development efforts.
PHASE II: Perform detailed design analyses and generate detailed design drawings for the selected track system concepts. Generate test plans for track sections and full track system qualification. Fabricate track sections and full track system for testing purposes on a surrogate AAAV platform of objective weight.
PHASE III: Mass produce sufficient quantities of track for the objective number of AAAV's anticipated to be procured. Investigate retrofit to existing, fielded track-laying vehicles.

COMMERCIAL POTENTIAL: Lightweight, durable, and quiet tracks would be welcomed by the construction industry for heavy vehicle use.

KEY WORDS: Mobility; track; road wheels; composite; amphibious; material

N98-012 TITLE: Power Density Improvements for Military Power Generators

OBJECTIVE: To significantly improve the energy density of military power generation systems to achieve substantial cost savings and promote inter-service component commonality.

DESCRIPTION: The AAAV is the Marine Corps' next generation amphibious assault vehicle which will incorporate significant improvements in communications, control systems, actuation systems, and sensors. These represent a substantial power load over and beyond the capacity of existing, lightweight power generation systems. This effort will develop new generator component technologies which may be applied to existing hardware to reduce acquisition time and promote commonality.

PHASE I: Utilizing the existing M1 generator as a baseline, the contractor shall perform conceptual design studies of rotating and stationary components, cooling systems, and power electronics, with the goal of increasing generator efficiency to 85%, allowing temperature independent voltage regulation, and providing the means to drive two generators in parallel form the same source. Conceptual drawings and prototype fabrication cost estimates shall be generated.

PHASE II: Perform detailed design of the concept selected during Phase I and generate all drawings necessary for the fabrication of prototype components. Procure sufficient components to build one enhanced prototype generator including spare parts and test support hardware. Generate a test plan, assemble prototype onto test bench, and execute plan.

PHASE III: Apply the technologies developed during Phases I & II to a mass retro-fit effort of the M1 generator to be installed in the AAAV during its production run.

COMMERCIAL POTENTIAL: This system could be used to reduce the weight and volume of electric drive and hybrid-electric vehicles which are evolving into economically feasible and technically viable transportation systems.

KEY WORDS: Power; kilowatts; generator; generator; rotor; stator

N98-013 TITLE: Geo-Elliptical Phased Array Satellite Tracking System

OBJECTIVE: The development of a Phased Array antenna system that will be able to track two simultaneously elliptical geo-synchronous satellites in the X-band, C-band and KU-band SHF frequency ranges and provide UHF "SATCOM-on-the-move" for tactical satellite communications systems .

DESCRIPTION: Today's tactical satellite communications systems uses parabolic antenna systems that must be stationary in order to acquire and track geosynchronous satellites, and each antenna can acquire and track only one satellite at a time. This is unacceptable in today's highly mobile battlefield environment. Naval vessels use gyro-stabilized platforms to compensate for the movement of the ship, however, this method is to expensive for vehicle mounted satellite systems. Therefore, a system that will allow dual satellite acquisition and will provide sufficient gain to ensure satisfactory link margins, while the vehicle is "on-the-move" will greatly enhance the critical command and control communications on the battlefield. The dual satellite capability and small footprint will greatly reduce the surface required for mounting the antenna, a fact that will be of great value on board Naval vessels. This capability has the potential to be used on several mobile platforms, i.e., the SHF Tactical Advanced Range extension

Terminal, Amphibious Assault Vehicles, Advanced Amphibious Assault Vehicles, HMMWV, Light Armored Vehicles, Helicopters, Fixed wing aircraft, and ships.
PHASE I: Develop state-of-the-art technology that will prove the concept of high-gain, phased array, SHF satellite antennas able to acquire two satellites simultaneously on any band combination in the X, C or KU bands. The same state-of-the art technology shall be able to provide SATCOM on the move on military wheeled or armor vehicles.
PHASE II: Build and test, using an actual prototype antenna, a phased-array, SHF antenna in the X, C and Ku bands. Antenna will be tested using the SHF Tactical, Advanced, Range extension Terminal (STAR-T) and HMMWV or armor vehicle.
PHASE III: Phase III will require military program sponsorship . For successful advance to this phase, a successful proof of concept must have demonstrated and the USMC sponsor for this SBIR effort will have coordinated transition to demonstration/validation. The contractor must support a successful Phase II transfer by maturing the product to a point for commercial consideration, including manufacturability and cost.

COMMERCIAL POTENTIAL: Commercial uses for the Phased-Array antenna in the C-band and Ku-band SHF frequency ranges is immediate. This technology will be able to satisfy commercial communications such as television stations, Cable TV companies, Down Link Stations for voice communications.

KEY WORDS: Phased-array; SATCOM; antenna; communications;

N98-014 TITLE: Disposable, Low Cost, Semi-Automatic Spotting Rifle

OBJECTIVE: Develop and demonstrate a disposable, low cost, semi-automatic rifle to be incorporated as a spotting rifle for various shoulder fired weapons.

DESCRIPTION: The current spotting system used to aim the Shoulder Launched Multipurpose Assault Weapon (SMAW) is a rifle attached to the missile launch tube and ballistically matched to the rocket being fired. The rifle must be capable, as a minimum, of meeting the present SMAW spotting rifle's hit requirement of 7.5 x 7.5 ft sq target at 500 meters. It must be semi-automatic and capable of firing up to 10 rounds. This effort may include investigation of simpler operating systems, new light weight materials, and unique manufacturing processes aimed at lowering unit cost. The effort should include ruggidization of the unit after development of the prototype for use in field conditions or other hostile environments. Issues should also address the application of new materials to this requirement described above (e.g, advantages, limitations, tradeoffs) as well as affordability and manufacturability in production.
PHASE I: Preparation of a technical report describing the proposed rifle system including engineering details of rifle functioning, ammunition, and production approaches. The report should include alternative methods of development, tradeoffs, limitations of each alternative examined,

projected performance and operational characteristics of the selected alternative. If feasible, a preliminary proof-of principle demonstration as part of the Phase I effort would be beneficial.
PHASE II: Development, demonstration, and delivery of a proof-of concept spotting rifle with ammunition suitable for demonstrating and characterizing the system.
PHASE III: Production versions of the spotting rifle for engineering test and field evaluation.

COMMERCIAL POTENTIAL: The application of cost saving materials and simplified designs that would be needed to make a disposable spotting rifle could be applied to reduce the cost of firearms for law enforcement and for others using firearms.

KEY WORDS: Firearms; sighting/ranging/spotting systems; disposable.

N98-015 TITLE: High Accuracy Azimuth Sensor

OBJECTIVE: Development and demonstration of a prototype high accuracy (nonmagnetic-based) azimuth sensor suitable for use in man-portable and/or vehicle mounted applications.

DESCRIPTION: The proposed effort should address the development and demonstration of the technology to provide a compact sensor capable of measuring azimuth to an accuracy of 0.5 degrees or better. The sensor technology being sought must be compact, low power, suitable for integration into man-portable and/or vehicle mounted systems, and capable of operating reliably in adverse field conditions. The proposed effort should address issues associated with the use of the azimuth sensor in the applications described above (e.g., inherent advantages and limitations, tradeoffs, etc.) as well as issues of manufacturability and affordability in production.
PHASE I: Preparation of a technical report describing and examining the proposed azimuth sensor technology. The technical report should include the following information: theory of operation; projected performance and operational characteristics; current state of development; and proposed technical approach. If feasible, a preliminary proof-of-principle demonstration as part of the Phase I effort would beneficial.
PHASE II: Development, demonstration and delivery of a proof-of-concept device suitable for demonstrating and characterizing the operation of the azimuth sensor technology.
PHASE III: The azimuth sensor technology being pursued could be transitioned into the USMC Target Location, Designation, Handoff System (TLDHS) Program as well as numerous other tactical systems that require highly accurate azimuth information.

COMMERCIAL POTENTIAL: In much the same way that the precise position and time information capability provided by the Global Positioning System is a widely applied dual use technology; accurate azimuth information provided by a affordable, small, low power sensor could be employed in numerous man-portable and vehicle-based military and commercial systems.

KEY WORDS: sensors; azimuth; navigation; surveillance

N98-016 TITLE: Advanced SIGINT System

OBJECTIVE: To research and develop a signals intelligence/electronic warfare system capable of conducting intercept, direction finding, and electronic attack missions from non-dedicated ground and air platforms organic to the Marine Corps.

DESCRIPTION: The Advanced SIGINT System: 1) shall be functional on a wide variety of different fixed or rotary wing airframes, to include the UH-1N, CH-46, CH-53, MV-22, and C-130, 2) shall be mountable, in a period not to exceed six hours, by squadron or Radio Battalion personnel 3) shall be readily adaptable to use in other vehicular platforms, to include the AAAV, LAV, and HMMWV 4) shall be able to conduct signals intercept operations in the HF/VHF/UHF/SHF spectrums, 5) shall be able to conduct direction finding operations in the HF/VHF/UHF spectrums, 6) shall conduct electronic attack operations in the HF/VHF/UHF spectrums 7) shall comply with all safety of flight regulations and pose no threat to the operator, 8) shall be powered by battery or vehicular power supplies, 9) shall not exceed 200 pounds, 10) shall require no structural changes to the existing platforms.
PHASE I: Identify or develop an integrated antenna system, intercept system, electronic attack system, and direction finding system, suitable for use on airborne and ground based platforms. Develop plan to integrate required functionality into a single unit, to include a technical drawing package, functional specifications, configuration criteria, costs and availability. Develop solutions to all safety of flight issues and interference cancellation problems. Provide a detailed plan of the Phase II effort.
PHASE II: Build two engineering development models and conduct developmental testing in a field environment. Collect data to verify performance capabilities and provide a final product evaluation report.
PHASE III: Phase III will require military program sponsorship. The contractor must support a successful Phase III transfer by maturing the product to a point for commercial consideration, including manufacturability and cost.

COMMERCIAL POTENTIAL: The private sector industry can benefit from this technology. To this end, there are numerous applications for the system. Helicopters being utilized by Emergency Medical Services would have an ability to monitor multiple emergency channels. The direction finding applications could be used by forestry officials in order to more effectively track firefighting resources and wildlife. Federal law enforcement agencies could make use of the full range of system capabilities.

REFERENCES:
1. Family of Collection and Utilization Systems (FOCUS) Mission Needs Statement (No CCC35)
2. Family of Lightweight, Advanced, Mobile-Mounted, Electronic-Attack Systems (FLAMES) Mission Needs Statement (No CCC 32)

KEY WORDS: multi platform; antenna; suite; portable; Electronic Warfare, SIGINT

N98-017 TITLE: Modular Remote Electronic Attack System

OBJECTIVE: Enhance the capability to conduct Electronic Attack (EA) from tactical intelligence systems organic to the Marine Corps. The Radio Battalions require the ability to utilize EA during Radio Reconnaissance Teams (RRT) special missions. Currently fielded systems have been unable to incorporate EA capability suitable to the special employment constraints of these teams. Previously, size, weight and power requirements precluded the use of EA on RRT deployments. A self-contained modular EA application that can be incorporated via wireless LAN into organic RRT intelligence gathering systems will overcome the employment issue and will extend the Radio Battalion's ability to conduct EA into the forward edge of the battlefield and during special operations. This capability will significantly enhance MAGTF electronic attack capabilities. The light-weight, remote capable, wireless LAN EA module will be capable of interfacing with the Marine Corps Radio Reconnaissance Equipment Program SIGINT Suite-1 (RREP- SS-1) system. Remote connectivity is required out to 5 kilometers. The EA module should include on-board power, remotely tunable transmitters, and remotely controlled power output.

DESCRIPTION: The modular remote EA system: 1) should be able to be controlled from the SS-1 and a variety of different fixed or mobile control stations. 2) should be deployable within a short time period by RRT, Radio Battalion, and other advance force personnel, 3) should be able to operate in the VHF/UHF/SHF spectrums, 4) should support the RRT employment concept as it relates to size, weight and power consumption.
PHASE I: Research existing EA and remote systems technologies. Investigate frequency allocation issues, software interface and other design issues that lend themselves to the alliance of the two technologies. Develop functional specifications, configuration criteria, costs and availability. Provide system design and an outline of the Phase II effort.
PHASE II: Fabrication of up to eight engineering development models capable of being tested in a field environment by users. Collect data to verify performance capabilities and provide a final product evaluation report.
PHASE III: Phase III will require military program sponsorship. The contractor must support a successful Phase III transfer by maturing the product to a point for commercial consideration, including manufacturability and cost.

COMMERCIAL POTENTIAL: The private sector industry of wireless LAN technologies and IP data transfer, as well as Other Government Agencies, can benefit from this technology. There are numerous applications for modular remote control capability systems. With the swap-out of EA with conventional transmitters, the wireless LAN and transmit control functions of the system could be adapted to anyone or any architecture that utilizes direct transmit control functions. Additional users can be provided transmit services without the cost of additional transmitters. Department of Transportation, Emergency Medical Services and law enforcement officials could have the ability to remotely activate vehicle radio and transportation monitoring equipment.

REFERENCES: Operational Requirements Document (ORD) for the Radio Reconnaissance Equipment Program (RREP) No. CCC 1.43

KEY WORDS: Electronic Attack (EA); SIGINT; remote control; LAN; man-packable

N98-018 TITLE: Air-Delivered Sensor Orientation Technology

OBJECTIVE: The objective of this topic is to develop the technology that enables Air-delivered Sensor (ADS) detection arrays to self-orient to a reference azimuth. The end result of the application of this technology is an ADS that provides information on target direction, direction of movement, and target velocity. These Air-delivered Sensors are dropped from Marine Corps/Navy high performance tactical aircraft in support of amphibious operations and expeditionary operations ashore.

DESCRIPTION: There is a requirement in the Marine Corps to orient Air-delivered Sensors. Currently, the Marine Corps has air-delivered sensor technology, however, there is an implied requirement in refining this technology to enable a sensor to determine target location, direction of movement, and target velocity.

PHASE I: Explore the application of technologies required to passively determine the direction orientation of ground-embedded sensors after they have been dropped from tactical aircraft. This technology must be small enough to be packaged in existing Marine Corps ADS stores, operate on low-level power, be capable of withstanding the shock and vibration of transit aboard tactical aircraft, specifically, the F&A-18 Hornet, be capable of withstanding the shock of ground implant, be accurate to within 5 degrees, and be capable of operating in a wide range of weather conditions. Additionally, this phase should address performance goals and provide evidence that the goals are technically feasible as well as identify all necessary efforts required in Phase II.

PHASE II: This phase entails the demonstration of the proposed technology to include: (1) Self orientation, (2) Integration into an existing Marine Corps sensor store, and

(3) Delivery from Marine Corps high performance tactical aircraft to include ground implant.
PHASE III: Produce the hardware and any associated software/firmware developed in Phase II.

COMMERCIAL POTENTIAL: Application of this research will benefit numerous security systems manufacturing companies seeking to provide a wider range of target information. Any resultant technology has a wide range of application in drug/law enforcement as well as the defense industry. Additionally, such technology has application in commercial, hand-held navigation aids.

REFERENCES:
1.   Air-delivered Sensor Report, Applied Research Labs (ARL), University of Texas at Austin
2.   Advanced Air-delivered Sensor (AADS) Requirements Summary, Users Conference, Marine Corps Systems Command

KEY WORDS: Sensor; Air-delivered; ADS;   self-orient; Marine: aircraft

NAVAL AIR SYSTEMS COMMAND

N98-019   TITLE: Stand Alone Environmental Corrosivity Measurement System

OBJECTIVE: To design and develop a low cost integrated data acquisition and sensor system which can measure the following parameters: Environmental corrosivity, temperature, relative humidity and rainfall conductivity.

DESCRIPTION: Corrosion costs the Navy in billions of dollars every year. Currently there is no means of quantifying environmental corrosivity as a function of the basing and operational environments. There is a need to develop a system which can obtain baseline environmental corrosivity measurements packaged such that the form factor is amenable to installation on Navy ships and bases. Part of this effort would be to design and develop a low cost integrated data acquisition and sensor system which can measure the following parameters: environmental corrosivity, temperature, relative humidity and rainfall conductivity. The system must be capable of unattended operation for at least 6 months and offer the option of remote data collection via modem or other wireless communication technologies. A methodology for automated data analysis will be required to support the interpretation of collected data.
PHASE I: Determine the feasibility of developing and designing a low cost integrated environmental corrosivity sensing and data storage system and fabricate a prototype.
PHASE II: Build several (at least ten) units of environmental corrosivity sensor systems as developed in Phase I. Install at least three systems: (I) at a ground station on a Naval Aviation Depot; (ii) on an aircraft carrier and (iii)on an operational aircraft. Collect and analyze data obtained during a minimum of one year test-exposure period.
PHASE III: Demonstrate the ability to manufacture low cost environmental corrosivity sensing systems (system hardware

cost under $10,000/unit). Demonstrate the transition opportunity for fleet application in terms of reducing O&M costs through funding from NAVAIR (proposed 6.4 CBM Program) or other commercial interests.

COMMERCIAL POTENTIAL: This system offers dual-use potential of monitoring effects of environmental corrosion on commercial structures including: commercial aircraft, bridges, oil & gas platforms and pipelines, underground tanks, concrete rebars, hazardous waste storage facilities etc.

REFERENCES:

1. V.S. Agarwala, "Sensors for Corrosion Detection and Monitoring in Hidden Areas", proceedings of the Symposium on "Chemical Sensors II," Eds. M. Butler, A Ricco, and N. Yamazoe, The Electrochemical Society, Pennington, NJ, Vol 93-7, 698-708, 1993.
2. V.S. Agarwala and A. Fabiszewski, "Thin Film Microsensors for Integrity of Coatings, Composites, and Hidden Structures", NACE CORROSION/94 Conference, Baltimore, MD, Paper No. 342, NACE International, Houston, TX.

3. V.S. Agarwala, "Corrosion Monitoring of the Shipboard Environment", STP-965, American Society for Testing and Materials, Philadelphia, pp 354-365, 1988.
4. V.S. Agarwala, "In-Situ Corrosivity Monitoring of Military Hardware Environments", NACE CORROSION/96 Conference, Baltimore, MD, Paper No. 632, NACE International, Houston, TX., P. 632/4.
5. V.S. Agarwala, "In-Situ Corrosivity Monitoring of Military Hardware Environments", NACE CORROSION/96 Conference, Baltimore, MD, Paper No. 632, NACE International, Houston, TX.

KEY WORDS: Corrosivity monitor unit; Sensor; data acquisition; "health" monitoring; low cost system; dual-use technology

N98-020 TITLE: Intelligent coatings for the detection and monitoring of corrosion on metallic surfaces

OBJECTIVE: To develop a reliable, real-time, field portable non-destructive (NDI) corrosion inspection system using intelligent coatings.

DESCRIPTION: The detection, monitoring and characterization of aircraft and ship structural integrity is essential for both military and civilian safety, affordability and reliability. Corrosion is one of the most critical element for cost and useful life today. Smart chemicals (intelligent coatings) have been developed and demonstrated to provide an early warning detection of corrosion by-products at the incipient stage. Present system (intelligent coatings) utilize UV radiation to excite fluorescent materials which either fluoresce upon combination with ions released during corrosion or fluoresce upon oxidation due to exposure to oxygen and moisture reaching them.
Thus far these techniques have been demonstrated in the laboratory; there is a need to develop optical

instrumentation to record, store and analyze the data in the field. System concepts should include dye embedding techniques (encapsulation, polymer or sol-gel), imaging cameras (CCD, MCP), spectroscopy (lifetime, steady-state), and electronic integration (software and hardware i.e. DSPs, PCBs). Other spectroscopic techniques to monitor intelligent coatings will also be considered, such as absorption, magnetic resonance, SQUID, Raman, etc..
PHASE I: Explore and identify candidate intelligent coatings. Provide and demonstrate proof-of-concept of the proposed NDI technique.
PHASE II: Develop and fabricate a working NDI system using intelligent coatings. Demonstrate the technology on one fleet aircraft.
PHASE III: Identify funding source to transition this technology to NAVAIR and find a suitable industrial partner to develop a manufacturing process.

COMMERCIAL POTENTIAL: The developed NDI system would have broad military and commercial applications for aircraft, ships, storage tanks, missiles etc. which need early warning corrosion detection and monitoring. This NDI capability will result in lower life-cycle cost and reduction in maintenance man-hours of current military and civilian fleets.

REFERENCES:
1. V.S.Agarwala, "Chemical sensors for Integrity of Coatings", Proc. Tri-Service Corrosion Conference, U.S.Army Materials Technology Lab., Watertown, MA, pp.341-349, 1992.
2. R.E.Johnson and V.S.Agarwala, Materials performance 33,4(1994): pp.25-29.
3. R.E.Johnson and V.S.Agarwala, CORROSION/97 Conference, "Fluorescence Based Chemical Sensors for Corrosion Detection", Paper No.304, NACE International, Houston, TX, 1997.

KEY WORDS: Intelligent Coating; Smart Chemicals; Affordable; Microcapsules; Embeddable

N98-021 TITLE: Improved Leak Location System for Aircraft Internal/Integral Fuel Tanks/Cells

OBJECTIVE To develop a simple, low cost, highly reliable method for detecting and locating internal/integral aircraft fuel tank/cell leaks.

DESCRIPTION: Locating and eliminating/repairing fuel system leaks, particularly in internal/integral fuel tanks/cells, is an important part of the maintenance and acceptance test requirements of Navy aircraft. Unfortunately, current leak detection techniques are antiquated, and, therefore, are labor intensive/costly and lack the ability to quickly and accurately locate internal/integral fuel tank/cell leaks. Specifically, vacuum/pressure, soap bubbles, ammonia and dye, fuel dye, ultrasonics and warm gas emissions are current leak detection techniques used by Government Navy aircraft maintenance/repair activities and contractors. Each of these leak detection methods have shortcomings; namely: (1) difficulties in removing trace substances used during leak testing, (2) difficulties in accurately locating fuel tank leaks and (3) labor and time consuming, and, therefore, costly. The benefits of this effort will include reduced aircraft down time and improved reliability/maintainability.

PHASE I: The primary activities during Phase I will be to identify a potential technology/system to improve on costly/manpower intensive techniques used to locate internal/integral fuel tank/cell leaks in repair, overhaul and production facilities. The system shall be light weight, reliable and utilize commercially available material. The system shall not decrease the reliability of the internal/integral fuel tank/cell. The contractor will be required to perform lab tests to show the potential for the technology and/or system to locate internal/integral fuel tank/cell leaks.

PHASE II: During Phase II the contractor shall demonstrate the technology on fuel cell test cubes or small scale tanks. The performance, effectiveness, sensitivity, weight, reliability and maintainability shall be evaluated and quantified.

PHASE III: During Phase III the contractor will propose their design concept for aircraft system implementation.

COMMERCIAL POTENTIAL: This system could be used in aircraft that use bladder, self sealing and integral type fuel cells/tanks.

REFERENCES:

1. MIL-T-27422
2. MIL-T-5578
3. MIL-T-6369
4. NAVAIR 01-1A-35

KEY WORDS: Fuel, Fuel Cells, Bladder, Leak Detection, Fuel Tanks

N98-022 TITLE: Innovative UAV VTOL Drive Technology

OBJECTIVE: To develop innovative propulsion system technology which would result in VTOL or near VTOL performance for UAVs

DESCRIPTION: The Navy is interested in developing innovative VTOL drive system technology for use on future UAVs. Currently VTOL UAV propulsion systems consist of rotary wing systems which are complex, or inefficient in forward flight, or they use tilting fuselages to generate high velocity and low mass airflow required for vertical takeoff and landing. The high velocity, low mass airflow designs are hard to control during wind gusts in hover. We are seeking innovative designs, that are not rotary wing or vectored thrust systems.

PHASE I: The offeror will provide a CFD and 6 degree of freedom models or subscale UAVs which demonstrate the proposed technology to meet the VTOL requirement.

PHASE II: Develop, test and operationally demonstrate a UAV utilizing the technology developed in the Phase I SBIR effort.

PHASE III: Produce the system developed during Phase II for transition into DoD UAV Programs.

COMMERCIAL POTENTIAL: This technology will have applications in commercial aviation for both passenger aircraft and in commercial applications of UAVs. Such as surveillance of damage in earthquake and forest fires.

KEY WORDS: VTOL, propulsion, UAV

N98-023 TITLE: Innovative Technology to Enhance Aircraft Software Configuration Control

OBJECTIVE: Develop an advanced innovative capability to evaluate the parametric effects of software changes during air vehicle, flight trainer, or related system acceptance testing.

DESCRIPTION: Testing modern Navy aircraft or Army advanced attack rotorcraft with integrated digital flight control systems can be very time consuming and expensive due to many factors, including the myriad of software changes made during the overall test cycle. Operational flight trainer acceptance also involves numerous software changes by the contractor trying to match performance requirements. The integrated test team needs an enhanced capability to help maintain configuration control during the test period. In the process of making software changes to improve performance, while trying to maintain configuration control, it is very important to determine precisely how a proposed software change will affect the individual subsystem being tested and the overall system being evaluated.

PHASE I: Determine the application of intelligent systems technology to software configuration control. Develop a plan for an innovative program to support the integrated test team by precisely defining the effects that any parametric software change has on previous testing and on the overall air vehicle. Define the program applications and limitations to a specified multi-service rotorcraft and its associated flight trainers.
PHASE II: Develop the innovative program documented in Phase I. Demonstrate analytically how the program can be used to enhance software configuration control for specified rotorcraft. Demonstrate application on a specified simulator or digital flight control system test. Correct problems and incorporate recommended changes resulting form the initial tests. Deliver the final product, with appropriate documentation.
PHASE III: Extend the system application to support testing a different configuration rotorcraft.

COMMERCIAL POTENTIAL: The configuration control software would be used to support a variety of commercial software acceptance test programs for aircraft.

KEY WORDS: simulation, rotorcraft, software, configuration control, intelligent system, trainer, digital flight control

N98-024 TITLE: Ceramic To Metal Joining

OBJECTIVE: Bond a ceramic matrix composite such as SiC/SiC or SiC/C to a metallic structure. This joint must withstand the environment experienced in Naval aircraft.

DESCRIPTION: Ceramic technology is a break through for aerospace applications because they are lighter, temperature resistant, and more corrosion resistant than our current alloys. These new materials are being utilized to reach the Navy's goal of increasing the thrust to weight ratio of it's current gas turbine engines. These mature materials are fully developed and are ready for insertion into turbine powerplants. However, there is a dearth of information on the successful bonding of ceramics to current superalloys. To fully capitalize the benefits of ceramic materials, they must be successfully bonded to metal substrates that can withstand and operate in the gas turbine environment. To date, bonding or joining of the ceramics has had limited success.

It is the purpose of this work to bond a SiC/SiC or SiC/C ceramic matrix composites to a metallic structure such as a conventional super alloy. This bond must have integrity at 700 C. It has been demonstrated that the two family of CMC's mentioned above are mature for immediate insertion in our current aircraft. Currently they are mechanically fastened to the metal substrate. There is a need to replace conventional mechanical attachment with bonding.

PHASE I A bonding procedure will be developed so that a SiC/SiC or SiC/C ceramic matrix composite will be joined to an existing superalloy. The bond integrity will be examined at ambient as well as 700 C. Coefficient of Expansion measurements will be taken and documented. A preliminary stress analysis will be performed.

PHASE II Upon successful completion of Phase I, a family of ceramic to metal joints will be investigated and tested in the marine environment. This will include the latest superalloys and SiC/SiC or SiC/C exposed to both oxidation and hot corrosion environments. The successful bond will be manufactured and the stress fields will be fully modeled. The composition and bonding procedure will be presented and documented to the Navy for evaluation.

PHASE III The CMC bond procedure in Phase II will be transitioned to engine manufacturers. Navy Laboratories can use the information from this SBIR as a data base for similar applications. This work can be directly and immediately applied in the fleet. A successful bond will permit engine manufactures to incorporate CMC technology into their engines.

COMMERCIAL POTENTIAL: Industry can benefit from this product by utilizing ceramics in numerous conventional operations. These include Auxiliary Power Units, Land base gas turbines, and Aircraft gas turbines. The product will permit the wide use of ceramic materials that are exposed to elevated temperatures.

KEY WORDS: Bonding, Joining, Ceramic, Composite, Metal

N98-025 TITLE: Thermoset Resin Development for In Situ Fiber Placement

OBJECTIVE: To develop a toughened thermoset resin which is suitable for in situ cure during the fiber placement process.

DESCRIPTION: Fiber placement is an advanced composite process which has the potential to significantly reduce the cost of composite manufacturing through the efficient use of automation. In situ fiber placement of thermoplastics has been investigated, and has shown considerable cost savings by eliminating debulk cycles during lay-up and the autoclave cycle normally required for fiber placed or hand laid-up parts. However, thermoplastic resins are expensive and have not been qualified for most naval aircraft structural applications. Toughened thermoset resins are used for most naval aircraft composite components, but these resins were developed for prepreg applications and have slow reaction rates which make them unsuitable for in situ fiber placement applications. A toughened thermoset resin developed with a higher reaction rate suitable for in situ fiber placement would potentially provide a cost effective alternative to standard fiber placement. This resin would need to have mechanical and thermal properties similar to currently qualified structural thermoset resins. The towpreg produced with the subject resin must be able to be used on existing production fiber placement equipment with only minor modifications.

PHASE I: The contractor is expected to formulate or modify a toughened thermoset resin with a reaction rate high enough to consolidate during the in situ fiber placement process at normal production speeds. The resin should be thermally and mechanically tested to establish Tg, rate of reaction, and fracture toughness. Initial prepreg (or towpreg) material should be evaluated by mechanical testing and microscopy examination.

PHASE II: Optimize the resin formulation if necessary. Demonstrate in situ fiber placement by fabricating and testing flat panels and one or more current naval aircraft components. Perform cost analysis to compare developed material/process to standard fiber placement process.

PHASE III: Choose a Navy fiber placed structure which could benefit from the developed material/technology. Assist prime contractor in the material and structural qualification/certification procedures with the new resin/fiber system. Use of existing tooling is encouraged.

COMMERCIAL POTENTIAL: Fiber placement of thermoset materials is presently being used on commercial as well as military aircraft. The development of an in situ resin system would improve the cost efficiency of fiber placement for aerospace applications by reducing labor, tooling, support equipment usage (autoclaves, ovens, vacuum tables), and schedule.

KEY WORDS: Fiber placement; in situ; resin; thermoset

N98-026 TITLE: Biofidelic Lumbar Spine for Human Response to Aircraft Ejection and Helicopter Crash

OBJECTIVE: To design and construct a lumbar spinal element that is compatible with the Hybrid III type manikins, which provides measures of tri-axial acceleration, provides measures of tri-axial loads and moments, and has biofidelity with respect to the human response to +Gz acceleration.

DESCRIPTION: The human operators of ejection seat aircraft and rotary wing air vehicles are subjected to severe vertical acceleration loads upon ejection and crash. Evaluation of the effects of such events currently utilize the state-of-the-art in automotive manikins. The dynamics of these events are so different from automotive crashes that these manikins, designed for the horizontal and lateral forces of a land-based crash, do not represent the spinal response to +z axis acceleration seen in human testing in vertical acceleration. As the current manikins do represent a good starting point for improvement, an improvement of the spinal element of the Hybrid III type manikin is desired that will provide measures of tri-axial acceleration, provide measures of tri-axial loads and moments, and exhibit biofidelity with respect to human response to +Gz acceleration.
PHASE I: Conduct a review of the current status of manikin spines and their responsiveness to vertical acceleration. Document the salient design characteristics of human response to vertical acceleration needed for a mechanical and electrical design. Design a prototype, complete with data package, that will exhibit these characteristics and meet the stated objectives.
PHASE II: Fabricate a prototype for each Hybrid III type based on the Phase I design. Perform bench level testing on prototypes in anticipation of government testing. Modify design based on test results available and produce a final design for the spinal element.
PHASE III: Once Phase II is completed, a follow-on Phase III effort is expected to manufacture the manikin spinal elements for testing in the ejection seat environment.

COMMERCIAL POTENTIAL: Such a modification would be used by all agencies and companies that perform biodynamic testing either for design of seating or qualification of such seats.

REFERENCES: Hybrid III: The First Human-Like Crash Test Dummy (SAE PT-44)

KEY WORDS: Ejection seat, Hybrid III, Biodynamic Testing

N98-027 TITLE: Phase Change Material (PCM) Enhanced Man-Mounted Liquid Active Microclimate Cooling System

OBJECTIVE: Reduce the size and power requirements of current man-mounted liquid active microclimate cooling systems through the use of phase change materials (PCM's). PCM's can be employed as microencapsulated PCM's circulating in an aqueous slurry, in bulk form as a heat sink for the cooling fluid, or both.

DESCRIPTION: The current Chemical/Biological (CB) protective ensemble imposes a thermal burden on aircrew which not only limits mission time but poses a physiological danger to aircrew operating in even moderate environments. A small man-mounted cooling system employing active liquid based technology would enhance mission effectiveness and more importantly, would prevent a hazardous rise in core body temperature. The use of PCM could reduce the size and/or power requirement of the cooling unit while providing the same cooling effectiveness. The cooling unit would circulate the cooling fluid through narrow gauge tubing sewn to an undershirt worn against the skin. The unit should be capable of providing cooling for a minimum of 2 hours and should be powered by a rechargeable battery. The unit should produce a minimum of 150W of cooling with 200W desired and should provide that cooling rate in an environment of 100?F at 15% relative humidity. Since the cooling undergarment cannot be doffed during CB operations the cooling fluid should be water based and should not pose a hazard to the aircrewman in the event of a leak. The ideal unit would weigh less than 10 lb.

PHASE I: Provide a comparison of the use of a PCM enhanced fluid and/or a bulk PCM heat sink to water in the same cooling system, thus illustrating a clear performance improvement. PCM's of various chemical composition and slurries of varying PCM concentration should be explored. Provide design data which defines an optimal chemical composition, concentration (if slurry) and/or amount of PCM for a particular environment/application and fluid capacity.

PHASE II: The Phase I data will be used to design/modify two systems in Phase II. Liquid active cooling systems will be developed which concentrate on a reduction in size and power requirement of the proposed units. The units will be tested and data provided to verify performance. The two units will be delivered to the US Navy for testing and evaluation.

PHASE III: Transition the units developed in Phase II into a Navy microclimate cooling program and production of units for commercial sales.

COMMERCIAL POTENTIAL: A man mounted active microclimate cooling system can be used in any industrial/commercial application requiring a reduction in heat stress.

KEY WORDS: Microclimate Cooling, CBR, Phase Change Material, Heat Stress

N98-028 TITLE: Development Of Fault Tolerance Analysis Tools For Flight Critical Avionics Systems

OBJECTIVE: The objective of this project is to develop advanced fault tolerance modeling and simulation techniques for flight critical avionics systems. This will increase the reliability, mission readiness, survivability, dependability and overall aircraft safety of flight while substantially decreasing the systems design, development, and integration time.

DESCRIPTION: Advanced flight critical avionics systems will place an increasing reliance on commercial off-the-shelf (COTS) processing and networking components. The fault tolerance or the ability of these systems to perform properly in spite of sporadic failures remains a major issue in their implementation in a military system. The problem is further complicated by the potential use of large numbers of smart components and subsystems as well as complex processing architectures. However, flight and mission avionics systems can be built using cost effective fault tolerance techniques to function normally even in the presence of failures. At present, modeling and simulation tools for systematically evaluating the fault tolerance, reliability, and dependability of these components and subsystems are either unavailable or not well suited for military applications. This program is aimed at the development of a systematic approach to the analysis of fault tolerance in advanced avionics systems. The tools developed under this program should support statistical dependability modeling and simulation based on Markov and Petri-net methods as well as functional fault-injection modeling and simulation. They should be sufficiently flexible to support virtual prototyping and analysis of both current and future avionics architectures.

PHASE I: Develop a set of metrics and use these metrics to evaluate capabilities of currently available fault tolerance modeling and simulation tools in terms of both quantitative and qualitative attributes. These attributers should be weighted in terms of each tools ability to meet the topic requirements and commercialization potential. Demonstrate theoretical basis for modifying available tools or developing new tools suitable for modeling and simulation of fault tolerance in military systems.

PHASE II: In association with a commercial developer of performance modeling tools, develop a complete set of modeling and simulations tools to support both statistical and functional fault-injection modeling and simulation.

PHASE III: Integrate the fault tolerance tools developed in Phase II onto the performance modeling system to market a commercial tool that will simultaneously model both performance and fault tolerance. Demonstrate the benefits of the integrated fault tolerant tool in a real world example such as on the JSF avionics, showing the cost saving associated with the design, development and integration.

COMMERCIAL POTENTIAL: The tools developed under this program will be directly applicable to commercial distributed and parallel processing systems which require a high degree of dependability and availability.

KEY WORDS: Fault tolerance, avionics, networks, reliability, dependability

N98-029 TITLE: Automatic Derivation of Traditional Anthropometric Measurements From Whole Body Scan Data

OBJECTIVE: Automatically extract traditional anthropometric measurements from a three-dimensional point cloud data collected by a whole body scanner for design applications (clothing, workstations, equipment, systems engineering) and define algorithms to statistically summarize.

DESCRIPTION: Anthropometric data provide the fundamental

basis for the design of protective clothing, military crewstations and cockpits, and individual equipment. Over 200 measurements have been defined as necessary or useful for these design applications. Using traditional tools, these measurements take about half a day to collect per person. Thus, traditional anthropometric surveys are rare and expensive (the US Navy's most recent survey was taken in 1964). New whole body scanning technology has been developed that provides body size and shape data in three-dimensional form, in seconds. However, most computer-aided-design (CAD) technologies expect two-dimensional inputs. A way to automatically define and extract two-dimensional anthropometric measurements from the three-dimensional point clouds generated by scanning systems needs to be developed. (Therefore, this method cannot involve traditional contact land marking).
PHASE I: 1) Describe in detail the technical approach to automatically derive two-dimensional data for both standing and sitting measurements, and 2) using US Navy provided scan data of a human subject, demonstrate the feasibility of the technical approach by accurately (data should not exceed error rates reported in TR-88/043) deriving 15 standing and 8 seated measurements specified by cognizant technical personnel.
PHASE II: Using the technical approach in Phase I, develop algorithms to 1) accurately derive 50-70 standing measurements; 2) accurately derive 40-50 sitting measurements on using US navy provided scan data; 3) develop software to statistically summarize data, and calculate multiple or bivariate regression equations, and correlation coefficients; and 4) provide software algorithms, software manuals, on-line tutorial, and other support.
PHASE III: Transition to the Navy's NRVANA program by integrating developed software with the source whole body scanner, CAD/CAM systems, systems engineering, and biomedical applications.

COMMERCIAL POTENTIAL: Automatic measurement of the human body using computerized systems will be indispensable for designers to apply accurate data to the design of consumer goods, such as automobile interiors, kitchen equipment, clothing, and industrial workstations and equipment.

REFERENCES:
1. Clauser, Tebbetts, Bradtmiller, McConville, and Gordon (1988) Measurer's Handbook: U.S. Army Anthropometric Survey, Natick Technical Report TR-88/043; NASA Anthropometric Source book 1024; DOD-HDBK-743

KEY WORDS: Anthropometry, body scanning, software, CAD, body measurement

N98-030 TITLE: Application Of Advanced COTS Architectures To Airborne Signal Processing and computing

OBJECTIVE: Develop a methodology for effectively using COTS based computers and processors in airborne applications.

DESCRIPTION: Historically, complex military system requirements have led to the procurement of unique hardware to provide the high throughput real-time processing and display necessary to satisfy complex mission objectives. In order to be cost effective, standards were developed for subsystem components including computers and signal processors to reduce the costly unique developments and corresponding Integrated Logistic Support (ILS) requirements associated with unique platform systems. Although the development of these computers and signal processors took up to ten years between development contract award and Initial Operational Capability (IOC), the standards met a need that was not yet satisfied by commercial-off-the-shelf (COTS) developments. The explosion in computer and signal processing technology has overtaken the need to specify and develop unique military system components and special military standards. A need exists to develop a methodology for effectively utilizing the COTS technology that advances on the order of three generations over a ten year period. This effort will assess the viability of using COTS based computers and processors in airborne systems as a cost effective alternative to custom designs.

PHASE I: Define the architectural capabilities and standards for a high performance, distributed system consisting of COTS components. This effort will define hardware elements, development and operational software environments and identify a real-time application with which to demonstrate the architecture.
PHASE II: Demonstrate an advanced hardware architecture composed of a state-of-the-art processor configuration which makes maximum use of off-the-shelf components, open system architecture, relies on commercial industry standard communication media and physical connections, and drastically reduces the number of unique components. This effort should show that the existing airborne computing system components can be upgraded and/or changed without extensive application code development.
PHASE III: Full development and production for commercial and military airborne processors is envisioned.

COMMERCIAL POTENTIAL: Any commercial airborne computing system could benefit from this technology. Potential markets include airborne communications, on board system management, flight controls.

KEY WORDS: COTS, real time computing systems, signal processing, network analysis, legacy system upgrades

N98-031 TITLE: Marine Mammal Detection for Environmental Compliance

OBJECTIVE: Develop acoustic or non-acoustic sensors and signal processing techniques to detect, classify and localize marine mammals who could be present in designated danger zone during explosive operations.

DESCRIPTION: Explosive and live fire testing of weapons systems and vessels in the ocean environment are permitted when there is no significant impact on the environment, marine mammals or endangered species. Current testing strategies designate a danger zone around the explosive event based on predictions of lethality and harassment to species which could enter the danger zone. Explosive operations are suspended when a species enters the danger zone and are resumed when the species clears the zone. Reliable sensors and signal processing techniques dedicated to detection and localization of marine mammals are required with sufficient hardening to operate for multiple explosive events.

PHASE I: Conduct analysis of marine mammal characteristics and behaviors which permit efficient detection and localization over the range of 0.1 to 10 km. Based on the analysis, predict sensing techniques and signal processing schemes which permit near 100% probability of detection. Develop a sensor design concept and development plan.

PHASE II: Develop a sensor test model and signal processing hard/software which can be demonstrated in situ. Identify critical manufacturing technologies to permit the mass production.

PHASE III: Produce system models with hardening which can be demonstrated in live fire operations and successfully transition into production. Conduct operational tests and report conclusions and recommendations for production.

COMMERCIAL POTENTIAL: This technology supports marine mineral exploration in the commercial sector and allows regulating agencies to both protect and survey marine mammal population densities.

REFERENCES: OPNAVINST 5090.1B

KEY WORDS: Explosive testing, Marine Mammals, detection, protection

N98-032 TITLE: Frequency Selective filter/Switch

OBJECTIVE: Develop an innovative means of selectively routing increased jamming power to one direction from an aircraft while not interfering with fore and aft jamming of emitters at other frequencies.

DESCRIPTION: Historically, pulsed and continuous wave (CW) outputs of an airborne jammer are combined in a microwave hybrid and then split for simultaneous routing to forward and aft aircraft antennas. Against certain radars it may be more effective if a selected frequency portion of the CW jamming is redirected in a particular lower hemisphere direction. This may involve reflecting the signal off the ground or off a chaff cloud or just focusing the energy in a narrower region to get more effective radiated power. In these cases the antenna gain may have to be increased and/or the microwave transmission line/component losses decreased. It may also be necessary to redirect portions of the CW spectrum to the alternate path and back while jamming power is applied, i.e., hot (high power) switching. In addition, the normally transmitted jamming signal may have to be attenuated so it doesn't reach the radar/missile receiver at a level higher than the redirected path. Since jammers must handle multiple radars, the primary jamming path should be maintained for normal pulse and CW jamming.

PHASE I: This study should determine which emitters could be more effectively jammed by using an alternate antenna on a tactical Navy aircraft. This study should determine the feasibility and develop an optimum approach for allowing a deployed jammer with a CW output to perform CW jamming via alternate antennas for selected frequencies while still using existing antennas for CW and pulsed jamming for the majority of the frequencies.
PHASE II: Fabricate a prototype implementation of the system. Testing should include effectiveness of jammer controlled antenna switching mechanism against modern day radar controlled missile systems.
PHASE III: Fabricate and deliver additional systems for test and integration into existing US Navy tactical aircraft.

COMMERCIAL POTENTIAL: The application is applicable to co-site signal interference reduction and upgrades to Foreign Military Sales (FMS) aircraft/jammer installations.

KEY WORDS: Continuous Wave (CW), Electronic Countermeasures (ECM)

N98-033 TITLE: Magnetic Anomaly Detection (MAD) Geomagnetic Reference Sensor

OBJECTIVE: Develop an off-board sensor of geomagnetic noise for use with Advanced Capability (ADCAP) MAD detection and recording systems.

DESCRIPTION: As platform noise is reduced in ADCAP MAD detection systems, background noise/ clutter sources begin to have a dominating influence upon detection performance. The geomagnetic noise in an area is correlated over ranges of at least several kilometers. An off-board sensor placed within the correlation range, but far from the expected target anomaly could be used to measure the geomagnetic noise. This could, in turn, provide potentially useful information to allow processing techniques such as common mode rejection to reduce the primary sensor's background noise and; thus, improve system performance. Recommended developmental phases are outlined as follows:
PHASE I: Quantify the performance gains possible from off-board measurement of geomagnetic noise in operational contexts. Develop system concepts and evaluate performance, cost and compatibility with potential airborne Antisubmarine Warfare (ASW) MAD systems and procedures. Explore all additional uses/value-added of the sensor option. Specify hardware/software requirements and sources for a prototype system. Propose and conduct appropriate risk reduction experiments.
PHASE II: Build and test prototype off-board geomagnetic sensor and signal processing software and hardware for noise rejection in the context of ADCAP MAD systems. The prototype need not be fully compatible with all ASW platform systems, but a clear and short development trail must be established to show how full compatibility could be achieved.
PHASE III: Develop and deliver off-board sensing system for use by ASW aircraft equipped with ADCAP MAD system

technology.

COMMERCIAL POTENTIAL: Advanced magnetic sensors are presently under consideration for potential employment in various commercial applications. These include: Geological exploration, detection and characterization of underground bunker facilities and the potential to assist in on-site inspections to determine compliance with nuclear weapons test ban treaties. Noise reductions attained in the case of submarine magnetic anomaly detection could also be of significant value in these as well as other commercial developmental applications.

KEY WORDS: MAD, Magnetics

N98-034 TITLE: Multisensor Image Positioning System for Tactical Level Targeting

OBJECTIVE: To develop techniques for establishing the precise geometric relationship between tactically acquired imagery and other image sources which are tied to geodetic coordinates.

DESCRIPTION: Tactical level targeting requires the ability to coordinate tactically sensed data with GPS targeting coordinates. The intent of this topic is to solicit development of algorithms to perform automated positioning of different data types with respect to a single coordinate system. In particular imagery derived from electro-optical (EO), infrared (IR), and synthetic aperture radar (SAR) sensors should be considered. Particular attention should be paid to EO to SAR image registration. In addition, digital elevation maps (DEM) resulting from IFSAR processing and/or DTED should be accommodated and utilized when available. Performance bounds for performing the image-to-image registration with and without knowledge of the local terrain elevations should be investigated. The system should be flexible enough to position as few as two of the above mentioned data types relative to each other or as many as all of the data types mentioned. It is anticipated that representative data will be made available to verify the capabilities of the system developed under this effort.

PHASE I: Describe in detail the algorithms identified and/or developed to meet the requirements set out above for all possible combinations of data types. Estimate anticipated registration accuracies and bounds within which the proposed system can be expected to operate. Demonstrate the ability to ortho-rectify the imagery if necessary. Demonstrate performance of the techniques on limited data sets in an experimental setting. Address issues related to speed of processing and describe the benefits of this innovative approach over other proposed approaches. Research quality source code for performing these tasks should be delivered at the completion of Phase I.

PHASE II: Extend the approaches developed under the Phase I to accommodate a larger variety of data types, in particular positioning of forward looking imagery relative to down looking imagery (and vice versa) should be addressed. The focus of this work will be to address the handling of data

types containing a significant amount of perspective distortion as in imagery collected by a low altitude tactical UAV over very mountainous regions. Develop a prototype system for performing these tasks, expected deliverables include a detailed report of algorithms employed as well as standalone source code.
PHASE III: Expand the Phase II prototype into an operational system that can be easily integrated with deployed systems.

COMMERCIAL POTENTIAL: Techniques developed to fulfill the requirements of this topic will provide a flexible solution to many problems in surveillance, targeting, and multisensor data exploitation. The developed system will provide capabilities to assemble, update, and maintain geographical information databases using imagery collated from different sensor types and platforms. Given such a system, new imagery can be quickly integrated into the database so that site monitoring change detection tasks may be performed. The applications of such a system include search and rescue, forest fire monitoring, map generation, and counter-drug surveillance.

REFERENCES:
1. H. Li, B.S. Manjunath, S.K. Mitra, "A Contour-Based Approach to Multisensor Image Registration", IEEE Transactions on Image Processing, Vol. 4, No. 3, March 1995, pp. 320-334.
2. R. Chellapa, Q. Zheng, P. Burlina, C. Shekhar, K.B. Eom, "On the Positioning of Multisensor Imagery for Exploitation and Target Recognition", Proceedings of the IEEE, Vol. 5, Issue 1, January 1997, pp. 120-138.

KEY WORDS: Multisensor data, image positioning, image registration, targeting, tactical, digital elevation models.

N98-035 TITLE: Signal Processing and System Concepts to Exploit Passive Signals in Airborne Active ASW Missions

OBJECTIVE: Use advanced processing and system concepts to enhance performance of future airborne ASW systems operating in high clutter environments.

DESCRIPTION: Although future airborne ASW systems will rely heavily on active acoustic methods acquire and locate submerged targets, exploitation of passive target signals can provide value-added to the detection, classification, and localization phases of an active search problem. Operator workload during ASW search will be dominated by use of the active tactics and data analysis, and significant passive data may be lost if capability is not incorporated into the system design. This SBIR will address how passive signal exploitation can be used to enhance active acoustic search.
PHASE I: Define innovative system concepts, signal processing, and display techniques to exploit passive signals in an Airborne active search mission. The concepts must demonstrate value-added to the active search, as well as feasibility in implementation. The Phase I effort will identify the signal types to be exploited, and how the techniques will work in a system context.

PHASE II: Develop a working prototype of the techniques defied under the Phase I SBIR effort. The prototype system will be used to demonstrate the system concepts using real data furnished by the Government, and must be consistent with transition of the concepts to fleet systems.
PHASE III: Implement the systems concepts, and signal processing and display techniques in a fleet ASW platform configuration (P-3, S-3).

COMMERCIAL POTENTIAL: The systems concepts and processing techniques developed under this task can be applied to commercial sonar systems. Combined Active and Passive processing would be beneficial for marine mammal tracking and could be applied to commercial security and surveillance systems.

KEY WORDS: Anti-Submarine Warfare, Signal Processing, Passive Processing, Display Techniques

N98-036 TITLE: Light-Weight Airborne Repeater for Tactical Radio Networks

OBJECTIVE: To design, demonstrate, and develop a lightweight, low power combat net radio (CNR) repeater package which can be deployed in UAV's.

DESCRIPTION: The Navy is often required to support and implement tactical radio communications links for beyond LOS or extended range applications in difficult terrain. While alternate communications media (SATCOM, HF, etc.) are available, the use of these media can lead to excessive congestion and requires combat elements to transport excessive amounts of equipment and batteries. Successful development of an airborne relay capability will allow combat and support elements to use existing local area CNR assets to support extended range communications.
Three CNR airborne relay configurations are of interest to the Navy, which will select a single configuration for further development depending upon the results of the Phase I trade studies and analyses. The first configuration shall be similar in nature to a conventional re-transmission arrangement, with separate transceivers and antennas connected so as to effect a re-broadcast function. The second configuration shall be similar to the first but shall employ a single antenna. The third configuration shall also utilize a single antenna, but shall be implemented as a store-and-forward node for data traffic, as opposed to simultaneous or pseudo-simultaneous active transmission and reception as in configurations 1 and 2.
Issues to be addressed by the successful offeror include; Size, weight, and power of the candidate architectures; Compatibility with Naval UAV assets; Suitability for simultaneous voice and data access; Tradeoffs related to multiple vs. single antenna architectures; Implementation of the SIP SINCGARS waveform; INFOSEC implementation; Cosite interference and RF performance; Coding performance of SIP EDM modes.
PHASE I: Develop a top-level approach for each of the candidate configurations, addressing the issues listed

above. Each configuration shall support all SIP SINCGARS modes in a package consistent with the candidate configuration. Analyze each configuration to determine the optimum airborne relay configuration with respect to size, weight, power, cost and performance.
PHASE II: Develop a prototype of the optimum airborne relay configuration. Integrate this configuration within a suitable UAV platform and perform simulated operational testing.
PHASE III: Transition the prototype airborne relay configuration into a Navy production program.

COMMERCIAL POTENTIAL: An airborne relay capability can be adapted to a variety of platforms and utilized by law-enforcement agencies and other non-DOD organizations to support wide-area voice and data communications in remote areas or under emergency conditions when other communications media are unavailable. The technology, through RF and digital signal processing and coding, can be used to enhance the performance of spread spectrum wireless RF communications networks which are degraded by extreme near/far ratios.

KEY WORDS: digital radios, spread spectrum, SINCGARS, airborne relay

N98-037 TITLE: Optical Phased Array Sensor and Processor Development

OBJECTIVE: Develop sensor and image processor technology which provides a hemispherical area of regard and zoom capability using solid state technology and no mechanical articulation.

DESCRIPTION: Unmanned Aerial Vehicle (UAV) Electro-Optical sensors currently use the Edison paradigm (movement of the optical path elements) to accomplish panning, tilting and zooming within the sensor's area of regard. While the actual focal plane arrays are becoming increasingly denser and smaller, the articulation mechanisms have mechanical limitations which are expensive to overcome using traditional stabilization methods. Traditional methods also carry weight and power penalties. A solid state, non-mechanical, digital sensor and processor which allows high resolution pan, tilt and zoom would be light weight (less than 5 pounds target) and accomplish all the functions of an Edison based system via Digital Signal Processing. The Optical Phased Array and Image Processor (OPAP) would be employed using daylight and solid state uncooled FLIR technology providing day/night capability. Sensor capability would exceed MOKED 200/400 (target) while allowing a 90% reduction weight and volume, allowing more room for other payload integration on otherwise overtaxed airframes.
PHASE I: Provide a feasibility study which develops a method to increase the effective density (zoom level versus granularity) of the digital sensor and the accompanying processor software which allows digital pan, tilt, zoom and stabilization.
PHASE II: Develop, test and operationally demonstrate the

OPAP methods formulated under the Phase I SBIR effort. Provide field test units for integration into target UAV.
PHASE III: Produce manufactured units for installation on designated UAV's.

COMMERCIAL POTENTIAL: Lower acquisition and maintenance costs would make OPAP technology attractive for commercial sensor users such as security companies. The lower weight would allow development of light weight commercial UAV systems. The low cost and light weight would make this technology a simple add on sensor for law enforcement helicopters.

REFERENCES: EIA RS-170, NTSC, HDTV

KEY WORDS: digital sensors, Focal Plane Arrays, Micro-bolometer, FLIR

N98-038 TITLE: Low-latency, Protocol Independent, Network Interfaces for Advanced Avionics Systems

OBJECTIVE: Develop high-performance network interfaces consisting of protocol independent (either message passing or shared memory) software, and very low-latency hardware, which enhance portability, and interoperability between networks and computer architectures in advanced avionics computing and communications systems.

DESCRIPTION: Next generation avionics systems will require dramatic increases in processing to support capabilities such as digital receivers, battlefield wide information networks, and multi-platform, multi-sensor fusion. These systems will exploit parallel and distributed computing and will require concomitant orders of magnitude increases in network capacity and orders of magnitude decreases in latency. Commercial-off-the-shelf (COTS) technology must be used to control costs. One of the major impediments to the development of COTS-based high-performance computing and communications is the processor-interconnect interface. Current components emphasize heavyweight software interfaces and I/O-bus interfaces which curtail sustainable throughput of gigabit/second interconnects to as little as 100-Mbps and inflate message-passing latency into the milli-second range. This program is targeted at the development of a lightweight software interface for both message passing and shared memory, and a very low latency close-to-the-processor hardware interface. The software interface should provide lightweight communications, low-latency multithreading, application-to-network independence, object request brokering, interoperability, and portability across message-passing and shared-memory networks for distributed and parallel applications. The Common Object Request Broker Architecture (CORBA) development should be tracked and compatibility maintained. The hardware interface should provide throughput approaching either the processor-memory bandwidth or the sustainable interconnect throughput (whichever is less), with latencies of less than one microsecond, at a unit cost of less than $2000 in quantity. In addition, a ruggedized version of the hardware interface

should be capable of operating over the military temperature range.
PHASE I: Demonstrate feasibility of the interconnect interface by modeling and simulation of software and hardware throughput, latency, cost, functionality, size, power, and weight. Evaluate and select the COTS-based processor architecture, software components, and interconnect, to be supported.
PHASE II: Develop and demonstrate software and hardware interface prototypes. Evaluate prototypes for throughput, latency, cost, functionality, size, power, and weight. The results of this evaluation should be used to verify Phase I modeling and simulation results and to estimate the unit cost of military and commercial interface systems.
PHASE III: In conjunction with a commercial interconnect vendor, develop a low-cost integrated module and software suite suitable for both commercial and military applications.

COMMERCIAL POTENTIAL: The high latency and low throughput of software and hardware interfaces for high-performance interconnects currently available represents a major limitation to their introduction into commercial distributed and parallel clusters of workstations. The development of low-latency, high-throughput interface components would represent a breakthrough in the field of high-performance computing and communications. It would revolutionize the effectiveness of the many hundreds of thousands of COTS-based clusters of workstations in the field to better exploit advances in distributed and parallel computing.

REFERENCES:
1. IEEE 1394.2 Serial Express (Draft);
2. IEEE 1596-1992 Scaleable Coherent Interface;
3. Myrinet: A Gigabit Per Second LAN;
4. ANSI X3.288-1996 Information Technology - Fibre Channel - Generic Services;
5. Joint Advanced Strike Technology Program, "Avionics Architecture Definition, Version 1.0, Aug 9, 1994";
6. OMG CORBA 2.0/IIOP Specification.

KEY WORDS: Avionics data networks, computer architecture, high-performance computing, parallel computing, high-performance communications

N98-039 TITLE: Pulse Detection Electronic Hardware for Multi-discriminant Laser Radar

OBJECTIVE: Develop pulse detection algorithm and electronic hardware for laser radar for improved range accuracy and for full exploitation of the information content of the returned pulse.

DESCRIPTION: For a direct-detection time-of-flight laser radar seeker, high speed and compact pulse detection electronic hardware is needed to determine the range to target. Improved pulse detection algorithm could enhance the noise performance of the seeker, and could provide more precise range measurement. The returned pulse potentially

contain useful information that can be correlated with the material or type of reflector and other clues useful for target recognition. This electronic hardware must be able to process millions of pulses a second. As a minimum, it must provide as output the range and "intensity" of the pulse.
PHASE I: Develop pulse detection algorithm and software. Demonstrate performance and capability using synthetic returned pulses. Conduct a study to determine the trade between speed, complexity of algorithm, and features. Perform preliminary design of hardware. Identify and establish clear path to hardware mapping. Explore teaming arrangement for interface to a real laser radar. Deliver the algorithm, software and documentation to the government.
PHASE II: Concentrate on final design and fabrication of this pulse detection electronic hardware in ASIC or the like. Testing the hardware in an experimental environment in the laboratory. Access the performance of the pulse detection hardware including speed, range accuracy, noise performance, intensity channel fidelity, and other features. Iterate the algorithm/software enhancement, fabrication and testing process. Establish teaming arrangement for interface the fabricated hardware to a real laser radar. Deliver a current version of the algorithm and software to the government.
PHASE III: Fabricate a version of the pulse detection electronic hardware that conforms to the targeted laser radar in term of form factor, power, temperature, speed requirements etc. Assist in the integration of the pulse detection hardware. Field demonstrate the hardware by collecting laser radar images. Analysis the performance of the pulse detection hardware.

COMMERCIAL POTENTIAL: This could also improve the performance of laser radar used in robotics and those used in building highly accurate 3D CAD models used in manufacturing.

KEY WORDS: Pulse Detection, laser radar, ASIC, seeker, range, intensity.

N98-040 TITLE: Weapon System Operator Tactical Operation Aids

OBJECTIVE: Investigate the utility of using weapon system operator initiated voice commands for tactical software function initiations, in conjunction with Tactical Decision Aids (TDA's) and cueing of operator for action on high interest or critical situations.

DESCRIPTION: Develop the combined use of voice commands, tactical decision aids, and cueing as a form of TDA to increase weapon system operator performance in high load scenarios. The combined enhancements to a weapon system have the potential to significantly reduce operator workload while increasing the WSO's ability to react and proact to potentially hazardous situations.
PHASE I: Provide a feasibility study to determine the best mix of cueing and voice recognition functions to be implemented in the tactical platform. Interact with

tactical operators and software development teams to:
1. Determine the basic tactical functions to be employed in the voice recognition system.
2. Determine the best cueing methods and under what circumstances they should be initiated.
3. Determine the TDA's that should be developed and how they should be initiated and modified if required real time.
4. And enhance the operational effectiveness of operators and pilots.

PHASE II: Develop, test, and operationally demonstrate the voice recognition, cueing, and Tactical Decision Aids on the operators situational awareness in a lab environment.

PHASE III: Produce, test, and operationally demonstrate the voice recognition, cueing, and Tactical Decision Aids in a tactical display and its effects on the operator or pilots situational awareness.

COMMERCIAL POTENTIAL: Numerous applications in air traffic control, industrial production monitoring, power plant control and distribution.

KEY WORDS: Voice Recognition, Cueing, Decision Aids

N98-041 TITLE: Low Cost, Light Weight Optics For Improved Multi-Function EO Sensor Performance

OBJECTIVE: Reduce the cost and weight of reflective optics and structures for EO multi-function sensors through use of BeA1 material, replication and bolt together alignment.

DESCRIPTION: Electro-optical sensors for air, helicopter, ship and submarine applications increasingly require multi-wavelength performance to provide functions such as color TV, NIR TV, laser ranging and designation, and MWIR plus LWIR imaging and tracking. To provide these functions through a common aperture, sensors require wide FOV all reflective, off axis fore optics which are sensitive to alignment and costly relative to lenses in a barrel. Weight is an additional cost and complexity driver, particularly for tail mounted and mast mounted systems where weight limitations drive designs to the extremes of weight reduction. This effort will reduce the weight of EO sensors by enabling use of BeA1 for both the optical structures and mirrors; BeA1 has 3 times the stiffness, 0.78 the density, half the CTE and 4 times the damping of Aluminum which is currently used for athermal, precision machined, bolt together reflective optics. The higher stiffness and lower density imply substantial weight savings and the lower CTE will ease sensitivity of the optics performance to thermal effects. The effort will further reduce the cost by taking advantage of advances in replication technology that are being made by ARPA on the precision optics manufacturing program. This SBIR will take both BeA1 and reflective optics replication technology through to practical application in Navy optical systems.

PHASE I: Provide a study to take BeA1 and replication technology into the design of off-axis three mirror WFOV telescopes needed for the fore optics in future multi-function EO-sensors.

PHASE II: Perform the design, fabrication and test of a concept developed in phase 1. The BeA1 and replicated optical telescope will be tested over thermal and other environments typical of air and helicopter borne sensors.
PHASE III: Transition the reflective optics system into a Navy program for performance evaluation in an operational environment.

COMMERCIAL POTENTIAL: The technology can be applied to many applications ranging from law enforcement and multi-spectral earth resources monitoring to a new class of amateur telescopes and accessories for the professional photographer.

KEY WORDS: Reflective optics, replication, EO sensors, Structures.

N98-042 TITLE: Environmentally Adaptable Detector/Classifier

OBJECTIVE: Design in situ environmentally adaptive algorithms to automate detection and classification processes for a Coherent Active Sonar Search System.

DESCRIPTION: The Navy is currently developing Active Sonar detection and classification automation for coherent waveforms to reduce operator workload and to aid in their decision making. This is critical to the success of the Search mission; because multi-beam/ multi-static sensor data and limited analysis time severely restricts the operator's ability to manually analyze and classify target/clutter returns. The goal of this effort is to develop environmentally robust algorithms that significantly increase detection and the ability to discriminate target returns from clutter. A number of important echo properties used for detection and classification are a function of the environment. These properties can be extracted real time from multi-static direct blast returns during the initial Search activity. Knowledge of the medium's effect on the transmitted signal can then be incorporated into the algorithms to optimize performance. The algorithms must be based on direct blast properties that correlate well with corresponding target returns. The algorithms must be integrated into current coherent baseline processing architecture and written in MATLAB.
PHASE I: Compile and evaluate sea test statistics of relevant environmentally dependent properties to determine their detection and classification merit. Statistical target/clutter probability curves need to support these conclusions. Quantify correlation between the direct blast and target properties and develop the techniques to utilize this information in the automated algorithm design. Select, develop, and test prototype detection and classification algorithms. This task will require using existing sea test data and leveraging off of on-going Navy sea tests to obtain the necessary statistical data base. Planning and supporting sea tests are required. Deliver a summary report with recommendations for phase II.
PHASE II: Develop and test prototype detection and classification algorithms and integrate into the coherent

processing architecture. Generate appropriate probability curves to assess performance. Continue to participate in Navy sea tests to gather more statistics over a variety of environments. From this data refine and test algorithms. Deliver a summary report with recommendations for Phase III.
PHASE III: Transition of prototype design to fleet. Conduct three sea tests at different environments to verify algorithm performance stated in phase II. Assist Navy in implementing algorithms into P-3 avionics. Support the Navy in evaluating their performance in the Tech Eval phase.

COMMERCIAL POTENTIAL: Use by the acoustic commercial community to aid in detection, classification, and tracking of marine mammals for purposes of study and protection.

KEYWORDS: Detection, Classification, Active Sonar Search.

N98-043 TITLE: Advanced SAR Techniques Including UWB/UHF for Mine and Unexploded Ordnance Detection/Classification

OBJECTIVE: The objective of this topic is to explore and transition advanced SAR techniques, particularly in the low frequency UWB/UHF region, through new and novel analysis, processing, and system techniques including (but not limited to) those applied to foliage penetration (FOPEN), ground penetration (GPEN), mine detection, and unexploded ordnance (UXO) detection/classification.

DESCRIPTION: Synthetic Aperture Radar (SAR) imaging is being used increasingly in a broad spectrum of all-weather military and nonmilitary applications. Bands of interest include X band but also include greater interest of late in the UltraWideBand (UWB) UHF (and lower) frequency range. Areas of importance to the Navy littoral surveillance mission span from wide area surveillance and target cueing to target ID and accurate geolocation. Also of increasing interest are terrain characterization and mapping, particularly in rugged forested regions for military as well as commercial and environmental application. As the spectrum of potential geographic regions of interest grows, more robust analysis, processing, modeling, and implementation techniques are required in order to accurately characterize targets and clutter in the respective terrain environments. Novel, robust analysis approaches to optimal focusing, statistical terrain and target characterization, polarimetric terrain and target characterization, ground cover species identification, RFI/interference rejection (particularly for low frequency foliage/ground penetration systems), image formation/registration, interferometric terrain mapping, FOPEN 3D target characterization, and FOPEN GMTI/GMTIm will be of greatest interest and impact for future systems. Mine and UXO detection/classification are included as representing among the most difficult challenges during, and particularly following, regional conflicts. All efforts will be coordinated with other Services and DOD agencies involved in UXO applications.
PHASE I: Explore new and robust modeling and analysis

techniques in order to demonstrate the greatest feasibility of improving the SAR image formation process and image product with the overall goal of extracting optimal information from terrain scenes over various littoral region types. As a minimum, algorithms and techniques should be provided with stand-alone prototype codes, where appropriate, for demonstration of feasibility and evaluation.
PHASE II: Using the technique(s) developed in Phase I, extend and improve the design(s) for robust performance over a variety of terrain and target types. Quantitative performance measures will be developed and applied for comparison to current/conventional techniques over diverse sets of government supplied SAR data. Where appropriate, hardware and/or software products will be expected.
PHASE III: Transition algorithms and techniques into ongoing projects, both military (ONR, DARPA, NAVAIR, etc.) and nonmilitary (e.g., environmental and/or commercial).

COMMERCIAL POTENTIAL: The utility of low frequency SAR is only now emerging as an important remote sensing tool for environmental as well as disaster response applications. The ability to penetrate foliage, and to some extent the ground, could have profound impact in some areas such as forest wetlands management, geological/resource exploration, and law enforcement (in terms of counter drug surveillance in remote regions). Robust imaging techniques will be required in order to extract optimal information from this data.

REFERENCES: "Proceedings of SPIE AeroSense Conference, Algorithms for Synthetic Aperture Radar Imagery II," Spie Proceedings Vol. 2487, 19-21 April 1995, Orlando, Fla.

KEY WORDS: SAR; image formation; focusing; motion compensation; statistical characterization; unexploded ordnance (UXO), speckle, polarimetry, GMTI, interferometry, IFSAR, mine detection

N98-044 TITLE: Innovative Signal Detection for Impulsive-Source active sonar systems operating in shallow water

OBJECTIVE: To develop innovative signal detection algorithms for air-deployed active sonar systems that use impulsive sources, sonobuoy receivers and operate in highly cluttered littoral environments.

DESCRIPTION: To successfully operate in the coastal waters around the world, the Navy must be able to reliably detect the presence of enemy diesel-electric submarines operating in these areas. While impulsive-source active sonar systems can provide the acoustic energy necessary to detect submarine echoes, reflections of this energy off the complicated sea bottoms in these shallow waters can produce numerous "false" or clutter echoes. For an active sonar system to be effective, it must be capable of distinguishing these clutter echoes from actual submarine echoes. Current energy detection algorithms cannot maintain a low rate of clutter detection while providing a high probability of target detection. Hence, there is a need to develop new detection algorithms.

PHASE I: The initial part of Phase I will be to develop several candidate detector structures and to evaluate their performance using simulated data. Next, the candidate detectors will be applied to a limited amount of real data and their performance compared to that of the "standard" energy detectors. These real data results will be used to assess the potential of the candidate algorithms to provide real-world performance improvements.

PHASE II: The candidate detection algorithms will be applied, in a lab setting, to all available at-sea data. The algorithms must provide good performance in all environments. As was done in Phase I, all performance results will be compared to those provided by standard energy detectors. The extensive real data analysis performed in Phase II will effectively quantify the improvement of the new algorithms over the conventional detectors. If this improvement is deemed sufficient, one of the candidate algorithms will be identified for transition to Phase III.

PHASE III: The detection algorithm identified in Phase II will be implemented in COTS hardware, installed on an ASW aircraft, and flown out to sea for real world testing. Tests will be conducted in a variety of environments to insure that the algorithms are providing the environmentally stable performance indicated in a successful Phase II effort.

COMMERCIAL POTENTIAL: Detection algorithms developed in this work are potentially useful in a variety of medical applications, including tumor detection and tissue pathology characterization with ultrasonic pulses. They may also prove useful in locating impulsive sound sources, like gunfire, that occur in the complicated, clutter-filled propagation conditions of a city.

KEY WORDS: active sonar, shallow water, impulsive source, signal detection, clutter rejection, signal classification.

N98-045 TITLE: Low Cost Adaptive Optics for Commercial and Military Systems

OBJECTIVE: Develop an adaptive optic system to extend capabilities of commercial and military imaging sensors in inclement weather.

DESCRIPTION: Imaging systems utilize reflected visible or infrared radiation to form images of the scene. The limiting factor in imaging is frequently the air turbulence caused by winds, high temperatures, and other weather conditions. This is especially true for long distance imaging in which air turbulence often degrades significantly the resolution capability of the sensor. Adaptive optics can correct the effects of air turbulence by sensing the incident wave front and reshaping the mirror to correct for the turbulence induced distortions. Current adaptive optical systems, however, are limited in their practical use due to high costs and bulky applications. A novel lightweight mirror system which distorts the mirror faceplate as needed, but requires little volume and which can be manufactured inexpensively would extend adaptive optic capabilities to dozens of commercial and military applications. Two or three competing concepts exist for accomplishing the inexpensive, small volume optical corrections. Two of them would be competitively selected in Phase I of this SBIR; the most promising would succeed to Phase II.

PHASE I: Conduct feasibility analysis to determine those conditions where adaptive optics may provide useful enhancement. Design an adaptive optic system to extend capabilities of commercial and military imaging sensors in inclement weather. The system will be lightweight, inexpensive to manufacture, and small in size. The system will be developed to operate in military seekers, FLIR (Forward Looking Infrared Radar) and commercial imaging systems.

PHASE II: Develop, Test and demonstrate under realistic conditions the most promising adaptive optic techniques proposed in Phase I. Seek commercial and military sponsors for Phase III.

PHASE III: Build prototype adaptive optical systems by the techniques demonstrated in Phase II. Apply to military seeker and FLIR systems as well as to commercial imaging systems.

COMMERCIAL POTENTIAL: New method will be used in telescopes, space-to-earth optical systems such as SELENE, security systems, airbourne surveillance, spotting systems and other commercial optical systems.

REFERENCES: References will be provided to DTIC for distribution to requesting bidders.

KEY WORDS: Sensor, adaptive optics, infrared systems, long-range viewing, atmospheric compensation and enhanced resolution

N98-046 TITLE: Embarked Aircraft Tracking System (EATS)

OBJECTIVE: Develop a system to automatically and continually locate, identify and track all aircraft embarked on an aircraft carrier from the time it is recovered until the time it is launched. Information from this system will serve as inputs to current, planned and future aviation information systems deployed on aircraft carriers. This system will contribute to an increase in aircraft sortie generation rate while reducing manpower.

DESCRIPTION: The aircraft carrier is a mobile sea based platform that provides power projection through tactical aviation. A measure of aircraft carrier performance is aircraft sortie generation rate. Sortie generation is driven by several factors, one of which is aircraft turnaround time. The current aircraft turnaround process is initiated upon recovery and includes: assessment of its condition, maintenance if necessary, refueling, ordnance loading, and one or two respots before taxiing to a launch

position from which it departs the ship. Aircraft condition and location are critical pieces of information for handling, servicing, and maintenance personnel. Currently, aircraft arrival, identification, status, and tracking are all done manually by many shipboard personnel transferring data via word of mouth. The data is then recorded/displayed by various means which include large grease boards and a manual spotting board using aircraft templates on two-dimensional scale models of the flight and hangar decks. This current method is manpower intensive, has a slow data transfer rate, is prone to the passage of erroneous data, results in additional aircraft respots, is inefficient, and results in increased aircraft turnaround time.
There are information systems under development that will be able to receive the information, process and then display it electronically but the data is still collected and communicated by humans. There is a need to develop a system of autonomously locating, identifying, and tracking the aircraft and then communicating the data to the new information system. This is a challenging task given the difficult shipboard conditions and constraints it must operate within.
The objective is to remotely acquire and track the location of each aircraft on the flight deck and hangar bay by side number and type, and present the information graphically in real time. This must be accomplished without altering the aircraft in any way (e.g. attaching bar codes to the fuselage, etc.). Technical challenges: (1) Aircraft are constantly moving and patterns of movement are unpredictable. Image recognition techniques must be able to acquire the salient characteristics (side number and aircraft type) of a moving target. It should be noted that side number can sometimes indicate the aircraft type, but this is not always the case, and building the redundancy of acquiring both would be required in any fielded system. (2) Aircraft are tightly packed and key edges and characteristics are frequently obscured. There is no tower high enough to give a "god's eye view" of either the flight deck or hangar bay where all edges of an aircraft can be seen. (3) The flight deck is approx 1080 feet long and 250 feet wide and can have the capacity for over 50 aircraft during operations. The hangar deck is approx 680 feet long and 108 feet wide and can have the capacity for 30 aircraft. The entire deck (either one) cannot be viewed by one single sensor. Rather sensor fusion techniques will need to be developed and applied. (4) Update rates would need to be fast enough to keep up with aircraft movement and display it smoothly without a "herky-jerky" motion.
PHASE I: Conduct a feasibility study which develops a concept for locating, identifying and tracking carrier embarked aircraft in real time. The concept must operate under severe shipboard conditions which includes: day, night, all weather, radio frequency/electromagnetic interference, and high clutter. The concept shall require little or no modifications to the aircraft (i.e. no electronic devices, etc.) and shall not interfere with flight and hangar deck operations.
PHASE II: Develop, test and operationally demonstrate the concept formulated under the Phase I effort on an aircraft carrier at sea.
PHASE III: Produce the concept as demonstrated in Phase II.

The concept will be transitioned to the Navy's Shipboard Aviation Systems Development Program.

COMMERCIAL POTENTIAL: This technology has many applications in the commercial sector including: inventory control for Roll-On/Roll-Off ships, container ships and warehouses; and for supporting ground control operations at large commercial airports.

KEY WORDS: aircraft, tracking, identification, information systems

N98-047 TITLE: Passive Target Velocity Measurement System

OBJECTIVE: Develop a low cost, compact Fabry-Perot interferometric system in order to passively measure the velocities of multiple targets in a cluttered environment.

DESCRIPTION: The ability to passively measure the velocity of moving objects allows covert measurement for target tracking and discrimination in a littoral or air environment. In the past, Fabry-Perot interferometry has been used successfully to measure the velocity of shock loaded materials. In this approach interference fringes are superimposed onto a two-dimensional image of an extended scene that is illuminated by a laser source. Doppler shifts are imparted to light scattered off of moving objects within the extended scene. The Doppler-shifted light passes through the Fabry-Perot etalon and fringes are formed. The pattern of the fringes change according to the magnitude of the Doppler shift. It is the intent of this proposal to demonstrate passive Doppler measurement using natural light sources.

PHASE I: Demonstrate technical feasibility through modeling for passive velocity measurement of moving objects in clutter; e.g. aircraft and missiles in a land and sea background. Luminosity throughput, resolution on F.O.V. and S/N with range are metrics of interest. The device should have large luminosity, high resolving power, and a wide field of view. It should also be able to measure the greatest possible velocity range and be frequency stable in adverse environments.

PHASE II: Develop a field system and demonstrate velocity measurements.

PHASE III: Demonstrate cost effective, compact, fieldable system.

COMMERCIAL POTENTIAL: Once developed, this system would have wide application for air turbulence avoidance, auto collision avoidance, space debris avoidance.

REFERENCES: A fixed etalon with an electro-optic material spaces may allow frequency stable operation over a wide velocity range.

KEY WORDS: Sensor, Fabry-Perot interferometry, Doppler shift

N98-048 TITLE: High Bandwidth, Secure, Portable, Wireless LAN

OBJECTIVE: Provide a secure/high bandwidth Wireless Local Area Network (LAN) for networking portable computing systems in a typical aircraft maintenance avionics environment.

DESCRIPTION: There are currently many efforts underway to move all of DON toward a complete digital aircraft avionics integration and maintenance environment. In response to the VISION state for the organizational (fleet) user, there have been several technology initiatives directed at flight line capable computer products. To date most of these efforts have used self contained data storage and processing to perform their tasks. Since the data and file storage necessary to perform avionics integration and maintenance can be quite large, another alternative is required for portable systems. The limitations of current technology are particularly apparent when the recall and storage of real time video and audio is required. Off loading the flight line system via a high speed (>20 Mbps) wireless network offers a logical solution. By making the portable unit a terminal on a network, the user could access database information available in the Automated Maintenance Environment (AME) and/or via "tele-maintenance" of real time audio, video and data to a remotely linked facility.
Current state-of-the-art wireless LAN technology does not provide data transmission bandwidths greater than 10 Mbps. This project will exceed this current limit. This effort proposes to develop a wireless LAN technology that will permit multi-user, secure, real time video, audio, and data transmission between a flight line computing device and a remote central processing unit. The wireless LAN must maintain reliable communication between the participants while they are located within or shadowed by the aircraft, hanger, or shipboard structures.
PHASE I: Determine a wireless LAN technology innovation suitable for integration with PC based operating systems.
PHASE II: Design, develop, test and demonstrate a prototype system in a squadron level or flight deck operation environment.
PHASE III: Produce the operationally demonstrated systems designed during Phase II. These systems will be expanded to support the full transition to the AIR 3.0 vision state for digital technical data.

COMMERCIAL POTENTIAL: This wireless technology will offer the commercial (automotive and large machinery maintenance, power plant monitoring, fire fighting, remote medical triage) communities a mobile control capability for portable computers which is compatible with commercial software and processor hardware.

KEYWORDS: Wireless LAN's / Portable computer control / Secure communications

N98-049 TITLE: Portable Ground Based Solid State IFF Situation Display System

OBJECTIVE: Develop a system which utilizes solid state and phased array technology to capture RADAR Beacon Service (RBS)/IFF data and display such data in a manner which provides the UAV operator with a situation display showing the position of the UAV and other aircraft near the UAV.

DESCRIPTION: Unmanned Aerial Vehicle (UAV) operations require that the UAV operator have a knowledge of air traffic in the UAV operations area. A man portable system is needed to interrogate the airborne traffic in the UAV operations area and provide relative position data to the UAV operator. Current systems are not man portable and are cost prohibitive. The advent of small, solid state transmitter hybrid circuits and phased array antenna technology makes the development of this system feasible. Ground based processing of the UAV mounted collision avoidance and RBS transponders can provide the needed information to the UAV operator.
PHASE I: Provide a feasibility study which develops a method to interrogate and display the position of the UAV and other RBS equipped air traffic.
PHASE II: Develop, test and operationally demonstrate the methods formulated under the Phase I SBIR effort. Develop algorithms which automatically target unacceptable closure rates and angles to report collision avoidance alarms to the UAV operator. Provide field test units for integration into target UAV systems.
PHASE III: Produce manufactured units for use with designated UAV systems.

COMMERCIAL POTENTIAL: The low cost to acquire the system will make it attractive to smaller public airfields and automation of the collision avoidance feature will enhance flight safety.

REFERENCES:
1. MK XV IFF
2. FAA RADAR Beacon Service

KEY WORDS: IFF, Phased Arrays, Hybrid Circuits

N98-050 TITLE: Corrosion Avoidance Materials

OBJECTIVE: Conceive, develop, and demonstrate new or alternate materials and/or coatings that are corrosion tolerant or avoiding for aviation support equipment (ASE) in sea based environments.

DESCRIPTION: Corrosion of ASE internal spaces, ASE body panels, ASE electrical surfaces (i.e., grounding points), and other non-structural, non-critical require frequent maintenance. Stripping, surface preparation and repainting are costly, occupy scarce resources, impact readiness and add to the hazardous waste problem. This effort will conceive, develop and demonstrate new or alternative materials or coatings that are more resistant to corrosion and fouling.
PHASE I: The contractor shall conceive and describe several new or alternative corrosion resistant/avoidance materials

and/or coatings (to be referred to as corrosion avoidance materials from hereon) for application to Naval ASE. Conceived materials shall include: (a) faster and less expensive stripping surface preparation techniques for maintenance; (b) be environmentally safe and compliant; (c) can be applied using techniques that are not hazardous to personnel or the environment; (d) benefits of utilizing such alternate materials; and (e) payback potential over the average life of the equipment.
PHASE II: Contractor shall finalize the selection of corrosion avoidance materials. Contractor shall select ASE components for application and demonstration, and determine their engineering characteristics to modify component designs to accommodate their manufacture from alternate materials. The contractor shall produce demonstration model components, and apply them on ASE for evaluation and demonstration purposes. The ASE shall be deployed on an active carrier or in a sea based environment for an evaluation period. Following deployment, the components' corrosion resistance and/or avoidance shall be evaluated and demonstrated.
PHASE III: The conceived corrosion avoidance materials will transition to the Naval Aviation Support Equipment Program Office (PMA-260C) for application to Naval ASE. In addition, the contractor will determine how the same materials/coatings can be applied to Naval ships and aircraft.

COMMERCIAL POTENTIAL: The conceived corrosion avoidance materials will have wide spread application in the Government, private, and public sectors. These materials can be applied to construction materials as well as transportation vehicles.

KEY WORDS: corrosion resistant; corrosion avoidance; materials; coatings; aviation support equipment

N98-051 TITLE: Electronic Schematic Archive

OBJECTIVE: Develop a methodology to automate the archival of electronic schematics in electronic format that is compatible to the Department of Defense (DoD) Automatic Test Systems (ATS) Computer-Aided Design (CAD) data base standards.

DESCRIPTION: The inventory of electronic schematics is heavily abundant with CAD data bases, IEEE standard schematic drawings, hand scribbles, and other unconventionally documented means, as well as in various sizes and dimensions. Due to the variety of formats, the access to, maintenance of, and revisions of these schematics is a costly logistics support burden (i.e., manpower intensive, manual intensive, time consuming). In some situations, these actions become unsuccessful which generate the need to redesign or backward engineer from actual hardware electronic schematics. These inventory efforts include the ability to interpret the various symbolic representations, i.e., wiring diagrams, nodal crossovers versus nodal connections, electronic components. This

effort will introduce advanced technologies for automated interpretation and archival of electronic schematics (legacy, present, and new)of all known formats into electronic format. The electronic format will be compatible to the defined DoD ATS CAD data base standards to allow for future CAD use, such as, the development of test/diagnostic procedures/programs, and testability design. Significant logistic burden reductions for the access to, maintenance of, and revision of, and extended life expectancy of schematics are expected benefits from this effort. In addition, hooks will be provided for interface to the Joint Engineering Data Management Information and Control System (JEDMICS).
PHASE I: Determine the complexity and feasibility of archiving electronic schematics of all known formats into electronic format. The contractor will also conceive and describe the advanced technology application for automated archival of electronic schematics of all known formats. This includes: (a) a narrative list of known electronic schematic format types; (b) description of how each format type will be autonomously archived, including cost benefits; (c) required system architecture, including estimated return-on-investment; and (d) how the application will interpret symbolic representations. In addition, the contractor will provide a description of how the conceived technology application will interface with JEDMICS.
PHASE II: Demonstrate the technology application conceived in Phase I. The technology application shall be performed for each known electronic schematic format type.
PHASE III: Transition to the Naval Aviation Support Equipment Program Office (PMA-260D) for inclusion to the DoD ATS Program.

COMMERCIAL POTENTIAL: The commercial sector is heavily stocked with paper schematics of electronic circuits. There exists a strong drive to archive these schematics into CAD data bases. As with DoD, these schematics are either hand-drawn, unconventionally generated, or Institute of Electrical and Electronics Engineers (IEEE) standard compliant. Regardless, all of these schematics remain to be archived in electronic format into CAD data bases. Therefore, the commercial sector also needs an affordable technology application to automate electronic schematic archival into CAD data bases, and in a format mutually accepted between DoD and the commercial sector.

KEY WORDS: archival; electronic schematic; electronic format; CAD; automate; legacy.

N98-052 TITLE: Non-Cadmium Brush Touch-up Process for Cadmium Replacements (IVD Aluminum, Zinc Alloys, Molten Salt) Repairs

OBJECTIVE: To develop a selective plating formulation that contains more environmentally friendly constituents than standard cadmium electroplates, to repair scratched or breached surface plates. The new formulation shall meet the performance of the electroplate it repairs.

DESCRIPTION: Currently, due to the toxic and cancerous

nature of cadmium a good deal of effort is now expended to find a replacement electro deposit(s)for electro deposited cadmium. These deposits invariably become scratched or breached requiring a touch - up repair.
PHASE I: Develop a non-hazardous elemental or alloy formulation(s) that meet current environmental laws/regulations and the performance requirements for its target application(s) at the Organizational and/or Intermediate maintenance level. Identify new formulations and potential applications. Conduct preliminary laboratory testing to demonstrate the feasibility of the new formulation(s) for its target applications.
PHASE II: Further develop a new electrochemical system meeting the objectives of Phase I results. Conduct both laboratory testing and field testing. The above testing shall demonstrate that the new electroplate meets all the performance requirements and environmental laws/regulations for target application(s). If necessary, propose amendment to existing government or commercial specification or propose new government or commercial specification for this electrochemical system to cover the technology.
PHASE III: Produce the electrochemical system demonstrated in the Phase II effort for both the military and commercial market.

COMMERCIAL POTENTIAL: The new electrochemical system can be used on commercial aircraft as well as non aerospace applications for both the government and private sector. Therefore, this technology is directly transferable.

KEY WORDS: Cadmium Replacement, Brush Plating, electroplating, touch - up, repair, Non-hazardous Pollutant

N98-053 TITLE: Develop Automatic Test System (ATS) Analysis and Configuration Management Tool

OBJECTIVE: Significantly reduce the cost of technology insertion with regards to Commercial Off the Shelf (COTS) and ATS modernization. Also reduce the cost of ATS comparison studies and Test Program Set (TPS) compatibility studies as precursors to ATS upgrade or replacement and TPS rehost.

DESCRIPTION: The proliferation of diversified test systems and test program sets have made it extremely expensive to upgrade testers, replace testers, and/or rehost TPS's. This tool would utilize the emerging Institute of Electrical and Electronics Engineers (IEEE) A Broad Based Environment for Test (ABBET) suite of standards to capture the information contained within a tester and the information contained within a TPS. The tool would further use the emerging standards to compare the compatibility of a TPS or suite of TPS's to a particular piece of Automatic Test Equipment (ATE). The output would indicate if a TPS or suite of TPS's could be hosted on the ATE, and, if not, what hardware would need to be added to the current ATE configuration to support the TPS('s).
PHASE I: Develop the requirements of the tool and identify framework issues, such as, platform, operating system, and

languages to be utilized. Also identified will be target TPS's and ATE. This phase will also address the feasibility of utilizing the emerging IEEE standards based upon their content and availability. Besides the requirements and feasibility studies, the results of this phase will include a complete schedule for Phase II.
PHASE II: Utilizing the framework elements, ATE, and TPS's identified in Phase I, the analysis and configuration management tool shall be created and demonstrated.
PHASE III: The final phase will be the utilization of the tool created in Phase II on additional ATE and TPS's. This phase will include modifications to tester and TPS models required by the tool.

COMMERCIAL POTENTIAL: The commercial potential is high with respect to the infusion of COTS equipment into current ATE. The tools will be based on COTS tools and languages with a wide capability toward portability. This tool would be 100% dual-use with the ability to analyze commercial or military ATE and TPS's.

REFERENCES:
(1) IEEE Trial-use Standard for ABBET Overview and Architecture revision draft 16.0, 11 April 1996.
(2) IEEE Proposed Standard for ABBET Resource Management 6.4, 13 December 1996.
(3) IEEE Proposed Standard for ABBET Test Resource Information Model draft 2.1, 1 April 1996.
(4) DoD Acquisition Policy Document 5000.2R.

KEY WORDS: Test, Rehost, ABBET, Test Resource

N98-054 TITLE: A Simulation Tool for Forecasting Training Throughput and Resource Support Requirements

OBJECTIVE: Develop and demonstrate a simulation model (tool) capable of forecasting training throughput and resource support requirements.

DESCRIPTION: Successfully planning and managing USN training programs demands substantial analytical resources. The internal dynamics of changing training needs, combined with dynamic shifts in personnel, creates difficult scheduling, performance and cost tradeoffs in planning and managing the training process. These difficulties are caused, in part, by complex feedback relationships that define system behavior. A system dynamics computer simulation model of the cause-and-effect linkages underlying personnel movements and training processes would significantly facilities training needs. The model should also allow users to quickly investigate alternative "what-if?" scenarios, both to test assumed data points and to understand alternative training option tradeoffs.
PHASE I: Determine the feasibility of developing a training continuum simulation model running under Windows95 on a personal computer (PC).
PHASE II: Develop a dynamic training continuum simulation computer model that runs under Windows95 on a PC. Based on initial verification and validation results, expand and refine the model. Using government supplied data, apply the

model to selected training programs to demonstrate the simulation model validity and utility. Provide the government with a completed application suitable for immediate use.

PHASE III: Disseminate to major system managers, BUPERS, CNET, and other training agents such as NAVAIR and NAVSEA for use in determining optimum training process, and student throughput and pipeline training requirements.

COMMERCIAL POTENTIAL: Many industries rely on extensive training programs to support required personnel skills. These companies would benefit from a simulation tool to assist in planing and managing training. Its use would also span other infrastructure and manpower system applications such as optimizing personnel strategies for both corporate and government entities.

KEY WORDS: Training; simulation; personnel; skills; modeling; system dynamics

N98-055 TITLE: Computer-based Training Conversion System

OBJECTIVE: Develop a comprehensive conversion system integrating a series of software and hardware components, which can predictably and consistently reduce both the cost and the lead time required to convert existing paper-based training systems into computer-based training (CBT) systems.

DESCRIPTION: A major portion of NAVAIR computer based training initiatives consist of converting existing courses into Interactive Courseware (ICW). To be most effective, this conversion process should take full advantage of existing training assets of these courses, re-engineer and complement these as required, and then use an authoring system to produce a highly effective ICW product. This can be a slow, expensive undertaking. A comprehensive process is needed to perform this task in a rapid, low-cost method which is predictable, repeatable, provides reusable ICW artifacts and is accessible to the wide range of organizations which may be expected to perform this work.

PHASE I: Conceive a comprehensive system to develop ICW from legacy training assets, validate this system and document lessons learned for users (ISD practitioners). The system feature open architecture; promote adoption of a common style guide; and, address inputs, through-puts, out-puts, operations and by-products off each step in detail. Validation shall be accomplished by using the system while converting a sample course module and significant metrics shall be collected. In this phase, the contractor may select his preferred components (Style Guide, file formats, scanner Authoring system, etc.). Lessons-learned shall address characteristics of legacy assets which produce the use of alternative branches within the process.

PHASE II: Expand the system developed in Phase I to be more compatible with various hardware and software characteristics commonly used in this discipline. Define the primary functional elements of the system, and define the characteristics of alternative hardware/software

architectures which will effectively support the system. Validate the system on a larger sample of courses and collect metrics which substantiate that use of this system produces the desired savings of cost and time, resulting in a highly effective training development tool.
PHASE III: The contractor will develop a highly productive method of converting legacy training materials into ICW. Final enhancements to promote commercialization will focus on fine-tuning the system (potentially including software/hardware upgrades) to be effective in a full-scale production application.

COMMERCIAL POTENTIAL: The system described above is totally Dual-use, having as much application in commercial/private sector training organizations as in the Military. Academia, private sector education training firms, and in-house training units of major corporations are engrossed in projects to convert their paper-based course materials into ICW versions and will have strong interest in a rapid and highly cost effective integrated tool to assist them in this urgent task. This assures a strong commercial market for firms who develop systems meeting the requirements of this topic.

REFERENCES: MIL-HDBK-1379D

KEY WORDS: Computer-based Training, CBT, Interactive Courseware, (ICW), Intelligent Tutoring systems, Data Conversion

N98-056 TITLE: Helicopter Weapon System Emulation Model

OBJECTIVE: The need exists for an ASW helicopter weapon system emulation model. The model will be used by program personnel to develop system understanding and to identify requirements for system improvements, man-machine interface changes, training and trainers. This tool will facilitate program tradeoffs and will provide lead time for necessary on-board computer system improvements.

DESCRIPTION: Development of a low cost modular software system to emulate a modern helicopter weapon system.

PHASE I: Develop a generic helicopter weapon system emulation model written with a COTS graphical user interface. The emulator is to be hosted on up to three personal computers on a LAN. The weapon system design shall be assumed to be a COTS, modular, open architecture hardware and software design with a number of on-board sensors including radar (with SAR/ISAR), IFF, ESM, acoustics (both sonobuoys and dipping sonar) and IRDS/LLLTV. A generic automatic flight control system as well as modern generic self protection, stores, navigation and communication systems shall be incorporated in the model. Programmable on-screen key sets shall be used to control system components and sensors. Incorporated in the model shall be a system resource estimator that outputs computer resource requirements in various system multimode scenarios.
PHASE II: Develop, demonstrate and test a full weapon

system emulator that includes simulated weapon system operations including sensor displays, target tracks, false alarms, and weapons deployments. Host the emulator on a COTS UNIX-based work station.
PHASE III: Use the technology developed in Phases I and II to produce a new class of low cost, highly adaptable system emulators and trainers. New methodology will allow for rapid system upgrades when new sub-systems or sensors are added to weapon systems in the future.

COMMERCIAL POTENTIAL: New system emulation technology can be used to develop control systems for a variety of commercial applications including manufacturing facilities, petroleum and chemical plants, and electrical power distribution and management.

KEY WORDS: Weapon System Emulator; helicopter; modular; software

N98-057 TITLE: Advanced Training Technology Delivery System

OBJECTIVE: Develop comprehensive training technology for use in training facilities using innovative delivery methods that will provide maximum leverage of technology projected to be available in the 21st century.

DESCRIPTION: Innovative techniques are solicited to deliver training via the Internet and Intranets using and integrating commercial off-the-shelf (COTS) equipment. Currently, this is only achievable utilizing standard desktop computers which are very costly and involve a high life cycle management and maintenance expense. The emphasis of this solicitation must be placed on (1) novel approaches and concepts for delivering training Computer Aided Instruction (CAI) and Interactive Courseware (ICW) over networked resources in a Client/Server environment using Intranets and the Internet, (2) support the delivery of Video On Demand (VOD) over the Intranet while assuring Quality of Service (QOS), (3) use an network system architecture conforming to open standards, (4) utilize low cost student terminals, (5) integral system software configuration management, (6) provide an instructor station capable of monitoring student activity, (7) incorporate electronic whiteboard technology, and (8) allow the automated updating of remote curricula via the Internet. This system must use emerging BISDN technology, low cost network devices, support both new and legacy curricula, and afford the delivery of instructional curricula to all systems attached to the Internet or Intranet. It is highly desirable that this system allow the direct reuse of software developed for aircraft systems to further reduce training acquisition costs and life cycle updates consistent with the currently fielded aircraft model versions.
PHASE I: Provide an exact description of the system to be designed, including proposed hardware, software and cost. Propose a means of measuring the systems ability to perform the task of delivering video and CBT over an Intranet.
PHASE II: Produce a viable prototype system and demonstrate its ability to support curricula over an Intranet.

PHASE III: Transition the technology to aviation schoolhouses and operational field activities over both Intranets and Internets.

COMMERCIAL POTENTIAL: Due to the ever increasing costs of travel expenses, distance learning is becoming essential in today's commercial environment. By allowing proficiency training over an intranet (or exported via the internet), schools, companies, and any organizations can conduct multi-faceted training on site instead of costly off-site courses. By utilizing a server-based network, and incorporating the innovative technology proposed in this SBIR, companies could take advantage of this training approach without the normally high life cycle costs (i.e. configuration management) associated with standard PC based network devices.

KEY WORDS: Distance Learning, Aircraft Training, CBT, High Bandwidth Telecommunications, Adult Education.

N98-058 TITLE: Imagery Database Retrieval and Indexing

OBJECTIVE: Develop new content addressable techniques for retrieval and indexing of imagery databases.

DESCRIPTION: One of the most important emerging computing technologies is the management of visual information. Processing of visual information requires management of large volumes of non-alphanumeric information, computations, communications, and visualization of results. As images are being generated at an ever-increasing rate, content-based information retrieval systems can effectively and efficiently organize (index) and retrieve visual information from large databases consisting of both textual and imagery information. Searching image databases using image queries is a challenging problem. Since information contents may include pictorial information to allow for multimedia applications and visualization, there is a need to query large on-line image databases using the image's content. In order to accomplish this, the objective of this project is to develop new querying techniques for imagery databases. This project shall explore the following new aspects and their resulting techniques integration into a unified search and indexing engine: (I) the derivation and computation of the most optimal attributes ('features') of images and visual objects that can provide useful query functionality for search and retrieval, (ii) adapting ('learning') user profiles for better performance, (iii) the development of retrieval methods based on similarity as opposed to exact match, (iv) query by image examples or user drawn images, (v) development of the pictorial querying language, design of the user interfaces, and (vi) query refinement and navigation.
PHASE I: Develop innovative concepts of content-based image retrieval, develop a search and indexing engine, and provide its initial experimental feasibility proof.
PHASE II: The Phase II would provide a beta version of the Phase I developed software system and its demonstration. As

the test-bed for the Phase II effort, imagery databases maintained by the Navy will be used (imagery databases used by naval simulators, target imagery databases).
PHASE III: During Phase III, the prototype will be fully scalable to support the commercialization of the product.

COMMERCIAL POTENTIAL: Software products resulting from this project can be used by various media commercial entities in such application areas as: FBI mug shots databases, medical imaging databases, media databases, and multimedia databases maintained by press agencies.

Key Word: Imagery Database, Image Retrieval, Image Indexing

N98-059 TITLE: Interactive Part-Task Training Over Local Area Networks (LANs) and the Internet

OBJECTIVE: Develop new software environments for semi-automatic rapid prototyping of part task trainers.

DESCRIPTION: The current developmental efforts for the part-task trainers confront several problems in the face of incremental advances in computer technology. Forward-Compatibility: The part-task trainers software is usually written in machine dependent programming languages for platforms that are currently unacceptably slow for the tasks demanded of them. Storage, Access, and Retrieval: Databases of part task trainers are usually very large (e.g. large target imagery databases). Security: Since target databases are classified as secret, security of the database and training system is required; however current systems can be easily accessed, copied, distributed, or modified. Portability: The machine specific codes in most cases need rework or recompilation in order to run on different systems. In order to fully address the concerns of forward-compatibility, storage, access and retrieval, security, and portability current rapid prototyping environments depend strongly on tedious and manual programming efforts. The main objective of this project is to automate a large portion of the prototyping process by introducing knowledge base and expert system techniques integrated with an object oriented paradigm. The developed approach will be used to analyze users requirements and automatically generate a "prototyping road map" accompanied by a library of re-usable components.
PHASE I: Investigate capabilities of current technologies for part task trainers prototyping. Develop a concept for the new part task trainer development environment.
PHASE II: Develop and implement beta prototypes for two part task trainers utilizing the Phase I developed environment.
PHASE III: Transition the Phase II systems to the multimedia authoring system for creating adaptive and interactive part task trainer development environments using the Internet technology.

COMMERCIAL POTENTIAL: The need for robust and current training systems is in great demand not only in the military but also in educational centers throughout the world. The software system resulting from this project can be easily modified to address the training needs of great many computer aided learning systems. It will serve several of the computer-based instruction industries, the computer network industry, and the interests of generations of students, educators, and trainees.

Key Word: Part Task Trainer, Authoring System

N98-060 TITLE: New Techniques for Compiling Multiresolution Terrain Representations

OBJECTIVE: Develop new technologies to automate synthesizing spatial objects from terrain databases at various levels of resolution to support the next generation of force representation simulations.

DESCRIPTION: A simulation may be regarded as composed of interacting objects that represent real-world entities. These objects can correspond to physical entities at various levels of abstraction. Interaction between objects is achieved by different execution mechanisms. Given that objects provide the fundamental units of simulations, the high-level architecture indicates the basic ways in which these objects will be generated and will interact with one another in a synthetic environment. Most of the current work on synthetic environment generation is concentrated on the generation of large virtual worlds utilizing virtual world databases. Examples of such systems include advanced distributed simulation including Simulator Networking (SIMNET), Battlefield Distributed Simulation (BDS-D) and Close Combat Tactical Trainer (CCTT); High-fidelity training simulators represented by the Special Operations Forces Aircrew Training System (SOF-ATS); Unmanned Ground Vehicles (UGV); and the development of detailed site models for automated imagery analysis (RADIUS). The spatial data requirements for many simulation programs generally include significant augmentation of standard products produced by the Defense Mapping Agency to address critical issues of timeliness, local geographical intensification, and operational security. They currently rely largely on manual and interactive compilation, which are labor-intensive and not well suited to demands of responsive database intensification and maintenance. The goal of this project will be to explore innovative and creative technologies that automate the process of synthetic terrain compilation.

PHASE I: Provide proof of feasibility for the proposed concepts.

PHASE II: Demonstrate and validate the most promising techniques for compiling multi-resolution terrain representations.

PHASE III: Enhance the Phase II prototype and implement final product(s) that can be interfaced with the government suggested synthetic virtual simulation environment(s). The final product will constitute the software library of various tools for compilation of terrain representations. The capability of porting these software tools to various simulation platforms will be an essential part of the final Phase III delivery.

COMMERCIAL POTENTIAL: The technology for automatic terrain generation in simulated environments will result in commercial tools that can be utilized across various domains. For example, they can be used by the computer game industry for rapid-prototyping of realistic terrain representations and by the entertainment industry for cost effective rendering of special effects in the movie production process.

REFERENCES: Defense Modeling and Simulation Office Program Master Plan, Marine Corps Modeling and Simulation Master Plan

KEY WORDS: Virtual Reality, Synthetic Environment Generation, DIS, Modeling, Simulation

N98-061 TITLE: Real-time High Fidelity Image Synthesis for Virtual Reality-Based Trainers

OBJECTIVE: Generate high fidelity, high resolution images in real time for virtual reality (VR)-based trainers

DESCRIPTION: The full potential of virtual reality-based trainers is far from being realized, largely because the available synthetic imaging technology is computationally intensive, slow, and yields low resolution images. In order to react in real-time to head and eye movements of the viewer, the image synthesizer must severely compromise image fidelity for the sake of speed. Even with these compromises, image generation often lags perceptibly behind head and eye movements, often inducing simulation sickness. Although capable of producing high quality images, conventional ray tracing algorithms are too slow for real-time image synthesis: thousands of rays must be traced from illumination sources through the medium to an image plan in order to form a high fidelity image. An alternative based on Gaussian beam tracing and helmet eye-tracking technology has some promise for overcoming these limitations.
The notion of exploiting the very limited resolution of the human eye (except in the retinal region called the fovea) has been explored. Using eye tracking technology and rendering only the few degrees in the field of view of the fovea, computational requirements on the image synthesizer can be reduced from hundreds of thousands down to a few hundred. This is not yet sufficient, however, to allow fully real-time image synthesis. Coupling this approach with Gaussian beam tracing as an enabling technology, however, shows the potential to reduce the number of computations to fewer than a hundred, which would be within the capability of affordable systems.
PHASE I: Develop and document the technical approach to a proof-of-concept technology demonstration.
PHASE II: Develop and demonstrate a prototype proof-of-concept system.

PHASE III: Transition prototype Gaussian beam based VR rendering and image generation system into a portable software package suitable for direct commercial and DoD applications. Develop interface specifications that will allow hardware vendors to develop software driver packages.

Specifically, develop interfaces for an AH-1W Aircrew Procedure Trainer (APT) with product applications available for commercial aviation trainers as well as military heavy equipment training.

COMMERCIAL POTENTIAL: Training systems in all aspects of government and industry will move to VR when the technology satisfies the business case. This technology can also apply to the entertainment industry as well as computer-aided design and prototyping.

KEY WORDS: Virtual reality, helmet-mounted display, training systems, ray tracing, image synthesis, Gaussian beam

N98-062 TITLE: Aluminum Nitride Infrared Window

OBJECTIVE: Develop a method to produce aluminum nitride seeker windows that are transparent in the 3- to 5-micron wavelength infrared region.

DESCRIPTION: Sapphire is the current material of choice for midwave infrared seeker windows on high speed missiles because it has the greatest thermal shock resistance of any available window material. Materials with twice as much thermal shock resistance are required for hypersonic missiles that are currently being planned. Aluminum nitride can potentially meet this requirement. Aluminum nitride has a strong birefringence, which has so far prevented the fabrication of transparent polycrystalline materials. Birefringence causes significant optical scatter which cannot be tolerated in a seeker window. The goal of this program is to fabricate aluminum nitride with a thickness of 2 millimeters, less than 2 percent scatter at a wavelength of 4 microns, an absorption coefficient less than 0.1 per centimeter at a wavelength of 4 microns, and a thermal conductivity above 160 watts per meter-kelvin at room temperature. Aluminum nitride windows should allow an increase in flight speed by about 1 Mach over sapphire windows.

PHASE I: Demonstrate the feasibility of fabricating aluminum nitride with at least 65% transmittance at a wavelength of 4 microns when the thickness is at least 1 millimeter.

PHASE II: Refine the process to prepare aluminum nitride disks with dimensions of at least 2 millimeters thickness and 25 millimeters diameter with the following properties: < 2% scatter at 4 microns; absorption coefficient < 0.1 per centimeter at 4 microns; and thermal conductivity > 160 watts per meter-kelvin 20oC. Material meeting the optical requirements will have a transmittance of 74% at 4 microns. Measure the mechanical strength of optical quality disks (25 mm diameter x 1.5 mm thick) using ring-on-ring flexure. Strengths should be measured on 20 disks at 20oC and 20 disks at 600oC. Target strengths are >200 megapascals at both temperatures.

PHASE III: Transition fabrication technology into a production facility capable of manufacturing 90-millimeter-diameter hemispheric domes (thickness = 2.5 mm) or flat rectangular windows with dimensions up to 100 mm x 200 mm (thickness = 5 mm) for use in a selected hypersonic missile system. Establish a database of physical properties including thermal conductivity, mechanical strength, modulus, expansion coefficient, and optical absorption coefficient as a function of temperature up to 1000oC. Develop an antireflection coating that provides >90% transmittance in the wavelength range 3-5 microns for 2.5 mm thick parts coated on both sides. Measure the change in transmittance of bare aluminum nitride and antireflection-coated aluminum nitride in rain and sand erosion experiments.

COMMERCIAL POTENTIAL: High purity/density aluminum nitride will be available for military and civilian applications (such as process monitoring) involving high thermal loads on optical windows, or as a substrate for high performance electronic devices.

REFERENCES:
1. D. C. Harris, "Infrared Window and Dome Materials," (ISBN 0-8194-0998-7) SPIE Press, Volume TT10, 1992

KEY WORDS: ceramics, aluminum nitride, thermal shock, infrared window, infrared dome; infrared seeker

N98-063 TITLE: Durable, Transparent, Electrically-Conductive Coatings

OBJECTIVE: Develop a durable, infrared-transmitting, electrically-conductive coating for a high-speed sapphire missile dome.

DESCRIPTION: Durable, electrically-conductive coatings are needed to replace the metallic mesh designs currently used to control electromagnetic interference (EMI) and radar cross section on missile domes and sensor windows. Mesh coatings made from soft metals like gold and copper provide effective shielding but are easily scratched and are not durable enough to be applied to the external surface of the sensor window where they would be the most effective. A mesh applied to the external surface of sapphire should be at least as hard as sapphire. No dip-coated materials will be considered for this application due to the extreme durability requirements of a high-speed missile dome.
The requirement is to achieve greater than 20 decibels of shielding from 400 MHZ to 18 GHz while maintaining at least 90% transmittance through the coating in the mid-wave infrared from 3 to 5 microns. These requirements are easily achieved with a metal grid or mesh coating. However, a mesh can only be designed to provide a given level of shielding for a specific range of EMI frequencies. Grids also degrade the off-axis optical performance of the seeker. It would be better to eliminate the grid structure entirely and use a continuous coating that has both the required electrical conductivity and infrared transparency.
PHASE I: Identify promising materials and coating processes. Fabricate witness samples of the most promising materials for preliminary characterization of electro-optic performance and evaluation of erosion-resistance.

PHASE II: Demonstrate a cost-effective, large-area, uniform coating process for simple and complex shapes. Provide samples for validation testing of electro-optic performance and impact resistance.
PHASE III: Production capability for depositing electrically-conductive, durable, optical coatings on missile domes and aircraft windows

COMMERCIAL POTENTIAL: Similar technology is required for optics, sensors, and photovoltaic arrays on commercial satellites where electrical charging and space-debris/micrometeoroid-impact damage severely limit the useful life cycle. Durable coatings are needed for fiber optic sensors used in severe chemical environments such as automobile and industrial pollution monitors. Electrically-conductive, durable coatings could be used to provide lightweight EMI shielding in many commercial products where electronic noise is a problem.

REFERENCES: MRS Bulletin, Applications of Intermetallic Compounds, May 1996, Volume 21, No. 5

KEY WORDS: sapphire missile domes, EMI shielding, reduced radar cross section, transparent conductors

N98-064 TITLE: Low-Cost, High-Fidelity, Portable UCAV Simulation

OBJECTIVE: To obtain a capability to cost-effectively simulate and test Uninhabited Combat Air Vehicle (UCAV) air-to-air and surface attack maneuvering tactics and UCAV control paradigms in realistic scenarios.

DESCRIPTION: The UCAV is a new and promising multi-role/multi-mission (air-to-air and air-to-surface) Naval weapon system concept. To obtain the full benefit of such a weapon system, air-to-air and surface attack tactical options and UCAV control paradigms must be explored. Because this new weapon system can be used in ways that were previously not possible, many new and different tactical options must be studied. Cost is always an issue - the ability to explore many types of tactics and control paradigms inexpensively is required.
Advances in personal computer (PC) systems make them suitable for some applications which were previously only addressable by sophisticated, expensive dome simulators. The use of PCS for such an application will result in a semi-portable dome simulator-like capability for a fraction of the cost.
If properly designed and built, a PC-based UCAV simulation would be an excellent tool for the analysis of UCAV tactics. Such a simulation could also be used as an environment in which various UCAV control paradigms could be tested and as a low-cost training tool for UCAV controllers/operators.
PHASE I: Analyze the feasibility of developing a PC-based, multi-station, high-fidelity, distributed air combat maneuvering (ACM) simulation capability in which each station simulates a UCAV or a manned threat aircraft. Some of the desired capabilities of such a simulation are: (1) all UCAVs, manned aircraft and weapons should be modeled at

the six degree-of-freedom level of fidelity; (2) UCAVs should be modeled as aircraft-like vehicles with a high maneuver capability; (3) station setting (UCAV or manned aircraft) should be menu-selectable; (4) each station should have a reasonable cockpit-like feel (throttle and stick, virtual console switches) and possess virtual reality goggles to show the pilot a cockpit display, heads-up display, scene, etc.; (5) frame rates and time lags should not be noticeable; (6) simple sensor models would be acceptable, but the possibility of higher fidelity sensor models should be investigated. If such a simulation is feasible, then one goal would be to use it to study UCAV algorithms which would allow the UCAV to fly autonomously, detect, track, identify and engage targets, send engagement information to a human controller, and receive final firing authority and other high-level commands from the human controller. Therefore, the analysis should address the possibility of allowing one or more UCAVs to be flown by computer (rather than by an operator at one of the stations), perhaps even to the point of allowing actual UCAV flight software to be implemented at some point. It should also address the possibility of including a human controller station and allow for the inclusion and testing of various UCAV control paradigms. Also, because it would be desirable to use the simulation to study the attack of surface targets by the UCAV, the analysis should address this possibility.

PHASE II: Develop, test and demonstrate the simulation based on the feasibility analysis performed under the Phase I SBIR effort.
PHASE III: Provide the simulation to current and proposed Navy UCAV projects.

COMMERCIAL POTENTIAL: If feasible, the simulation could be used to provide a low-cost flight simulation tool which would permit a number of students and air traffic controllers to train together in a realistic, multi-element environment. Given sufficient capability, such a simulation could be used as a lower cost alternative in many applications in which only dome simulators could be used previously, such as manned military and commercial aircraft trainers, and in some applications which have traditionally required full scale range tests.

REFERENCES:
1. "Technology Related to the Highly Maneuverable Lethal Vehicle (HMLV) Concept", DTIC Publication: AD-B217136

KEY WORDS: UCAV; 6-DOF; models and simulations; multi-station; training; analysis

N98-065 TITLE: Accelerometer-Based Multi-Sensor INS

OBJECTIVE: Develop an extremely low-cost inertial navigation sensor using only low-cost accelerometers, without any gyros, that provides high accuracy through the use of robust statistical point estimation.

DESCRIPTION: The potential exists to measure attitude and acceleration with only accelerometers. An inertial sensor based on such a configuration would have significant cost advantages over one based on gyros, since there are already extremely low-cost micro-machined accelerometers on the commercial market. However, there is still some work to be done in developing the algorithms for such a sensor system. In order to improve accuracy, there would be a large number of sensors per channel. The inputs to these sensors would be collected simultaneously and combined in a statistically robust, static point estimate. Point estimation would be required to avoid the use of filters that would create lags and contaminate the inertial outputs for use with other sensors in another filter, thereby avoiding the problem of filter driving filter. Robust estimators would be used to avoid requiring inordinately large numbers of sensors per channel.

PHASE I: Develop mathematical algorithms for combining accelerometer inputs to provide both attitude and acceleration for inertial navigation. Develop the robust statistical point estimators necessary for combining the measurement per input channel. Demonstrate with simulations that these algorithms work and through analysis show that they can be implemented in real-time on an existing platform. This analysis must include all the requirements and the design for a workable real-time device suitable for embedded applications.

PHASE II: Build a prototype device, including the sensors, processor, and software implementation suitable for real-time testing in a high dynamic environment.

PHASE III: Develop INS packaged for embedded applications for stand-alone navigation or for integration with other sensors, including GPS.

COMMERCIAL POTENTIAL: Besides the military applications for weapons systems and training ranges, an extremely accurate, very low cost inertial navigation system built with rugged, easily obtained micro-machined accelerometers and no gyros would have enormous utility in commercial, military, and general aviation as well as in land vehicle navigation and robotics.

REFERENCES:

1. Buford W. Shipley and Donna Jo Boughn, Evaluation of sensor systems for measuring rotational motion, Proc. 31" Annual SAFE Symposium, 1993.

KEY WORDS: GPS, INS, Accelerometers

N98-066 TITLE: Shape Charge Warhead Effectiveness Simulation, Including the Resultant Effects when Coupled with Current Shaped Charge Countermeasures.

OBJECTIVE: To develop a method to simulate the effectiveness of various shaped charge warhead designs in penetrating hard targets, to include performance in the presence of various countermeasures.

DESCRIPTION: Shaped charge warheads in current and planned weapon systems may be countered by a variety of techniques. This project seeks to optimize shape charge warhead design by modeling warhead performance and its countermeasures effects.

PHASE I: Determine the feasibility of developing a computer model or simulation that will accurately predict shaped charge warhead effectiveness in the presence of various types and amounts of countermeasures.
PHASE II: Develop and demonstrate the simulation model and its ability to precut countermeasures effects using data to be provided by government field activities. The model predictions must accurately reflect actual test results of armored vehicle countermeasure system effects(e.g. reactive Armor, Spall curtains) when hit by a TOW/HELLFIRE anti-armor type warhead.
PHASE III: Validate simulation model by a series of tests of the "then" configuration of the Joint Standoff Weapon (JSOW) penetration/Blast Warhead variant. The JSOW Penetration/Blast Warhead variant developed is expected to coincide with this SABIR effort, and will be critical to simulation model validation.

COMMERCIAL POTENTIAL: The resulting model or simulation could be used to predict the effects of various shaped charge explosives used in demolition, mining, "down-hole" oil well pipe perforation and construction.

REFERENCES:
1. Joint Operational Requirement for Joint Standoff Weapon (JSOW) System, USN Serial 301(1)-88-94
2. Department of the Navy Science and Technology Requirements Guidance, June 1996

KEY WORDS: Shaped Charge, Explosive, countermeasures, Warhead, simulation

NAVAL SEA SYSTEMS COMMAND

N98-067 TITLE: Wideband Fine Frequency Measurement

OBJECTIVE: To develop a wideband fine resolution frequency measurement apparatus for application in Electronic Support Measures (ESM) and EW Countermeasures (ECM) receivers.

DESCRIPTION: Wideband Fine Frequency Measurement (FFM) achieves a frequency resolution of 0.5 MHZ with an overall accuracy of 1.0 MHZ (RMS), allowing separation and measurement of closely-spaced signals in congested operating bands containing CW and copulse emissions. Pulse-by-pulse measurement capability over instantaneous operating bandwidths exceeding 500 MHZ at a sustained composite environment pulse-processing throughput of 7 Mpps is desired. On-pulse frequency measurement with minimum latency is a critical ECM requirement. This effort will fabricate and test a demonstration FFM unit suitable for rapid integration and field testing in support of current and planned EW/ESM and ECM systems, and to exploit commercialization opportunities.
PHASE I: Several promising approaches employing advanced technologies will be evaluated and based on these results, one selected approach will be pursued to the brassboard demonstration level in Phase II. Technical feasibility,

maturity of the technology, availability of evaluation devices, and estimated production cost will serve as decision criteria justifying further investigation. One selected approach will be demonstrated in breadboard form and thoroughly tested to ensure performance goals can be achieved and identify/correct limiting factors.
PHASE II: Design, fabricate and test a fully functional brassboard model of the FFM unit. This effort will provide the primary FFM hardware deliverable with embedded software and external interfaces. FFM operational functions including configuration, calibration, status reporting, and measurement data collection will be performed under control of an external COTS personal computer. Bench, RF simulator, and limited field testing will be performed to characterize FFM performance under a variety of signal environments. An ESM (or ECM) receiver compatibility/integration test is intended to demonstrate a system-level performance benefit resulting from FFM.
PHASE III: Transition FFM technology into a DOD and/or commercial product. The effort will repackage the FFM unit for operational (shipboard) environments, and provide electrical interfaces compatible with the selected ESM (or ECM) system application. Test and evaluation of system-level performance under complex RF simulator and field environments will be performed.

COMMERCIAL POTENTIAL: Wideband Fine Frequency Measurement technology has anticipated application in several product areas including RF test equipment, frequency band monitoring, dynamic allocation of spread-spectrum transmission channels, and identification of unknown signal types (for law enforcement agencies).

REFERENCES:
1. Tsui, J. B. "Microwave Receivers with Electronic Warfare Applications", John Wiley & Sons, 1986, p180.
2. Levitt, H. L., Alexander, E. M., Tse, A. Y., Spezio, A. E., "Super Resolution Precision Direction-Finding Techniques and Measurements", SPIE Aerospace Sensing and Control Symposium, Conference #2489, Orlando FL, April 18, 1995.

3. Polkinghorn, F. Jr., Farnham, H. "Ambiguity Resolution in the SPASUR Radio Interferometer Direction Finding System", Naval Research Laboratory Report 6603, Oct. 12, 1967.

KEYWORDS: situation awareness; electronic warfare; receiver; frequency; countermeasures; wideband

N98-068 TITLE: Real Time Software Upload/Download via Satellite

OBJECTIVE: Design and demonstrate a Real Time Software Upload/Download via Satellite for the purpose of making ship software deliveries and upgrades. This capability will permit a Software Support Agency (SSA) to transfer software directly from its offices to shipboard computers by means of Direct Broadcast Satellite (DBS) services.

DESCRIPTION: The major effort of this SBIR will be the development of a low-cost, prototype software delivery system; prototype demonstrations will be delivered in discrete phases. A major focus will be placed on the maintainability, usability, and integration of this ability with currently installed shipboard systems and present logistical processes.
The technical challenge is designing the software architecture so that it will work on existing ship-to-shore links and tightly integrated into the current shipboard computer systems and logistics procedures. This innovative approach will give platforms the ability to request a new download of software programs and/or data, which will eliminate the delay associated with the physical transfer of media, and the scheduling of maintenance personnel and activities. An early prototype will consist largely of Commercial Off The Shelf (COTS) components, although a trade study will examine whether eventual implementations can take advantage of the proposed Global Broadcast System (GBS) or other shipboard satellite systems.
PHASE I: Develop a design for a software upload/download satellite link, compatible with existing peripherals. Determine the required channel bandwidth, data throughput, encryption techniques, handling procedures and time latency for making timely software data deliveries. Frequency and effective radiated power will be handled by the satellite terminal and are not a design criteria. Deliverables will include the operational concept, system requirements, and system architecture for a prototype system, and a plan for testing the prototype.
PHASE II: Develop and test and demonstrate a prototype system conforming to the design of Phase I. The prototype will be designed and integrated into an actual SSA software delivery path and include computer equipment from representative hardware platforms. Demonstration will include data transfer, file encryption, and software installation. Deliverables include the prototype, development documents, user documents, test procedures and test results.
PHASE III: Conduct an operational test and evaluation between the selected SSA and a ship at sea using a second generation system to include an operational software package. Upon successful completion of Phase III, the capability will be ready for production and operational deployment by the Navy.

COMMERCIAL POTENTIAL: A commercial variant of this system can be developed for deploying custom-developed software and data for business transaction processing for geographically distributed businesses.

KEY WORDS: Satellite Link, Software Support, Direct Broadcast Satellite, Global Broadcast System

N98-069 TITLE: Low-Cost Nozzle Throat for High-Performance Tactical Missiles

OBJECTIVE: Develop a low-cost material, including fabrication approach and supporting property and performance design information, which provides zero-erosion performance in highly-aluminized propellant environments.

DESCRIPTION: Current high-performance tactical rocket nozzles, such as used in the Mk104, utilize multi-component construction with a tungsten throat. Although the tungsten throat provides satisfactory performance, significantly improved design flexibility, reduced cost and complexity (with attendant improved reliability), and improved nozzle efficiency is believed possible with ceramic matrix composite (CMC) materials. For example, a one-piece CMC nozzle shell could reduce overall motor cost by reducing the number of components and assembly cost. The need exists to: 1) define composite architecture (composition which provides zero erosion and reinforcement design which handles pressure and thrust loads, and thermal stress resistance); 2) develop low-cost processing technique; 3) verify material capability via proof-testing; and 4) develop analytical modeling and a property data base sufficient for design use.

PHASE I: Define a composite architecture and identify a composite processing approach to provide the described characteristics, above. A fabrication approach shall be also defined and cost estimated for production-level quantities. Perform experiments critical to verifying both architecture and processing and produce analytical predictions and/or experiments to provide high confidence of satisfactory demonstration of the fabrication approach in phase II. For example, critical chemistry and structural properties shall be defined and verified. The proposed processing approach should reflect a strong understanding of the material requirements (eg., thermal, chemical, mechanical) imposed by the rocket nozzle environment. Implementation of continuous-fiber-reinforced CMC nozzle shell geometry technology is suggested and preferred.
PHASE II: Develop and demonstrate the fabrication/processing approach, and verify the fabrication approach, defined in Phase I. Produce representative nozzle shells and demonstrate prototype component performance. Models (structural, oxidation, etc) initiated in phase I shall be verified experimentally. A materials property data base shall be initiated.
PHASE III: A full nozzle demonstration shall be performed and materials property data bases shall be completed.

COMMERCIAL POTENTIAL: The developed material fabrication approach would have broad application to the manufacturing of low-cost, high-temperature structural materials. For example, both liquid and solid propellant motor components for commercial satellites (orbital transfer missions) and earth-to-orbit vehicles could be produced at significantly lower cost and higher performance. Improved satellite station-keeping thrusters could significantly reduce satellite system cost by optimizing motor performance to enable longer satellite lifetimes. The materials fabrication approach could also be utilized to significantly reduce the cost of leading edge and nosecap materials for earth-to orbit and hypersonic transport vehicles. Finally, the fabrication approach could be utilized to inexpensively produce thermal-stress-resistant refractory materials such as those used as anodes for aluminum production.

REFERENCES:
1. Opeka, M.M., "Oxidation-Resistance and Utilization of Refractory Compounds. II. Thermodynamic Response Predictions for Solid Propellant Environments," Proceedings of 21st Annual Conference on Ceramic, Metal, and Carbon Composites, Materials, and Structures, Adv. Matls. and Processes Tech. Info. Analysis Center, Rome, NY, 1997.
2. Lally, F.T., et al., "Carbides for Solid Propellant Nozzle Systems," AFRPL-TR-68-164, 1 Oct 1968. (DTIC AD-843084)
3. Hawkins, D., et al., "Hafnium Carbide Matrix / Carbon Fiber Composite Payoff Study - Tactical and Strategic Missile Propulsion Applications," NSWCDD/TR-96/74, April 1996. (Avail DTIC)

KEYWORDS: tactical missiles, solid rocket motors, rocket nozzles, refractory materials and composites, low-cost composite fabrication, zero erosion, tungsten

N98-070 TITLE: Active Antenna Design Concept Using Microwave Power Modules

OBJECTIVE: Develop a design for military, air-cooled, active phased array antennas to be installed on multiple platforms using Microwave Power Module(MPM) technology.

DESCRIPTION: MPMs appear to offer an advantage in military RF systems because of their higher efficiency, high power, air cooled operation and relatively small size and weight. Current Cooperative Engagement Capability (CEC) Antennas are heavy, require liquid cooling lines in the ship mast, and extra ship space for Environmental Control Units (ECU). An MPM type, ship mast-mounted antenna application could be implemented without external cooling, offering much needed weight reduction compared to active, liquid cooled arrays. These antenna could also be used for land based sites, vehicles or modified for air platforms.
PHASE I: Develop active phased-array design concepts reflecting effective use of MPMs. MPM parameters shall be furnished by the Government. Specifications for frequency, pattern quality (sidelobe level), and bandwidth etc. require the contractor to have a secret clearance. Technical data on current antennas is available. MPM technology is under development at the Naval Research Laboratory (NRL). Design concepts shall be provided for active shipboard antenna and other platform applications for government selection in Phase II.
PHASE II: Develop a detailed preliminary design for a full shipboard CEC antenna, based upon the Phase I concept design and the MPM configuration selected by the government. The design shall be accompanied by performance analysis, and comparisons to the existing CEC active antenna. A cost analysis shall also be performed. Options for multiple platform application shall be provided.
PHASE III: Prepare fabrication drawings and fabricate a prototype active MPM antenna for tests. Tests shall be conducted to verify and investigate radiated power, beam forming, power consumption and overall efficiency, and other basic tests as agreed between the contractor and the government. A report shall be prepared by the contractor

with all design parameters and test results.
COMMERCIAL POTENTIAL: If MPMs prove to be cost-effective and also efficient in size and weight with better performance than is available in current and projected solid-state devices, there should be potential to use them in commercial radio, television, and radar systems. Present commercial applications are tube-based, the reliability and redundancy of multiple MPMs will be superior to standard high power TWTs or similar large devices.

KEYWORDS: active phased array antennas, Microwave Power Modules, cooling techniques, RF

N98-071 TITLE: Robust Adaptive Target State Estimation for Missile Guidance

OBJECTIVE: Develop and test a more accurate method for target state estimation and thereby improve the terminal homing guidance performance of interceptor missiles. More specifically, develop robust and adaptive new estimation techniques with respect to target maneuvers and seeker errors.

DESCRIPTION: Traditionally, interceptor missiles have employed classical terminal homing guidance laws such as proportional navigation. However, the threats have become faster, more stealthy and more maneuverable, and terminal homing miss distance performance requirements have grown more stringent, such as for "direct-hit" capability. To counter this situation, relatively newer forms of guidance that augment the guidance law with estimated target characteristics have been developed to try to improve terminal homing (miss) performance. However, the accuracy and robustness of the target state estimators to varying target maneuvers and characteristics have been one of the limiting factors of improving the interceptor's terminal performance. This effort will examine techniques to improve the accuracy of the onboard target state estimators, and thereby improve the miss distance performance of homing interceptors.
PHASE I: Formulate and develop a target state estimator that is adaptive and robust to varying target characteristics (such as various target maneuvers and radar cross section). Techniques may include, but are not limited to: robust H2/H-Infinity filtering, the Interacting Multiple Model (IMM) approach; robust, adaptive control/estimation; and/or neural / fuzzy-logic based methods. Demonstrate increased estimator accuracy and robustness compared to a more conventional estimator approach. Demonstrate improved closed-loop terminal homing miss distance performance in either a three degree-of-freedom (3-DOF), 5-DOF or simplified 6-DOF simulation of an interceptor missile against various types of targets and maneuvers, and including anticipated guidance and missile system noises.
PHASE II: Demonstrate improved terminal homing performance of an interceptor missile using the robust, adaptive estimator and guidance approach in a fully detailed, stochastic 6-DOF simulation against various type of targets and maneuvers throughout the performance envelope of the

missile. Ensure the computational feasibility of the algorithm for onboard missile computer utilization, and demonstrate operation and performance in an actual missile guidance computer, perhaps utilizing a hardware-in-the-loop simulation.
PHASE III: Transition the technology to an Advanced Technology Demonstration (ATD) missile program, or to a Pre-Planned Product Improvement (P3I) missile program, such as for STANDARD Missile - 2 Block IV P3I or the Evolved SeaSparrow P3I Missile.

COMMERCIAL POTENTIAL: Potential commercial applications of these techniques would benefit the aerospace, transportation, and radar industries. In general, these robust tracking techniques could be applied to various radar (tracking) systems, aircraft and aviation industries, satellites, missiles, unmanned air vehicle systems, and intelligent transportation systems.

KEY WORDS: Robust adaptive target state estimation, missile guidance, guidance filtering, tracking maneuvering targets

N98-072 TITLE: Combat System Software Migration to Open Systems

OBJECTIVE: Identification and development of innovative techniques to implement the migration of combat system application code to next generation processing systems. The need for open architecture and software standards is only recently recognized as necessary to the development of new technology and applications across various vendor's computing platforms. While standards exist in many areas of computer science, the existing commercial standards inadequately address all the needs of the combat system processing domain.

The techniques must support: 1) Hardware independence - the details of platform-specific features are transparent to the application programmer. Therefore, the underlying computer hardware and operating system may be changed without changing the application code, and 2) Interoperability - applications from other systems and platforms may be easily integrated into the existing system. This requires not only that the application code is portable to the underlying platform, but also that a common computational paradigm is used so that added functions inter-operate with the existing system without major changes.

DESCRIPTION: A Combat System Middleware Standard (CSMS) is required to provide a common computational paradigm and standard interfaces to the underlying platform, and define a software layer composed of standard, non-proprietary interfaces and supporting formats. The CSMS will provide: a means for achieving the goals of efficient development; implementation of new systems; simplified system integration; and portability of both source code and user skills. The purpose of the CSMS will be to promote software portability and reuse by providing a standard application program interface for combat systems. This facilitates hardware independence and interoperability of applications minimizes the need for personnel retraining and adaptation.

PHASE I: Investigate and define how the middleware computational paradigm, data type, constant definitions, and function prototypes can be implemented in the combat system processing domain. After defining the problem, identify, analyze, and compare alternative techniques
PHASE II: Develop a prototype middleware technology and will demonstrate the ability of the middleware design to meeting the processing requirements (support event reconstruction, message capturing, system timing, etc.) of Navy combat systems.
PHASE III: Integrate the prototype middleware technology into a Navy combat system.

COMMERCIAL POTENTIAL: The generic aspects of the middleware standard approach could be packaged into a CASE tool which will provide software application developers a software development environment which can create multi-platform, real time, enterprise applications.

REFERENCE: J. Ahrens and N. Prywes, "Transition to a Legacy- and Reuse- Based Software Life Cycle", Computer, Vol. 28 No. 10, Oct. 1995, pp. 27-36

KEY WORDS: Middleware; Distributed Processing; Object Oriented; COTS; Hardware Independence; Legacy Systems.

N98-073 TITLE: Low-Cost, Non-Rayon Carbon-"Phenolic" Composites for Rocket Nozzle Applications

OBJECTIVE: Identify alternate constituents, architectures, and/or processing techniques which provide equivalent performance at reduced acquisition cost versus SOTA rayon-based, tape wrapped carbon phenolic (C-Ph) materials.

DESCRIPTION: Tape-wrapped, rayon-based carbon-phenolic (TWCP) materials are used for ablator, insulator, and exit cone components in solid rocket motors (eg., Standard Missile Mk104). The cessation of domestic, aerospace-grade rayon production points to the need for new materials approaches for rocket motor construction. Advanced materials can include alternate fiber(s), fiber architectures, matrix compositions, and/or processing techniques. Equivalent, or improved, ablation/thermal/mechanical performance and domestic sources are required, as is lower acquisition cost.
PHASE I: Review existing materials/processes (M/P) for tape-wrapped component fabrication. Identify M/P variations which potentially reduce fabrication cost. Quantify (via estimation or experimentation) and prioritize cost reduction associated with proposed process variations. Prepare plan to evaluate cost reduction steps in phase II.
PHASE II: Evaluate cost reduction M/P variations identified in phase I. Evaluation may consist of process variation development, sample hardware fabrication, hardware test and evaluation to verify required properties (ablation, thermal, mechanical, etc.), and estimation of cost savings for component(s) or nozzle production.
PHASE III: As needed, additional C-Ph material shall be

produced to complete the property data base, and/or nozzle components produced on a pre-production basis to evaluate reproducibility.

COMMERCIAL POTENTIAL: Polymer matrix composites (PMCs), including carbon-phenolic materials, are widely used in commercial (sporting goods) and DoD (aircraft aerosurfaces) applications. The development of lower cost fabrication techniques could be useful for cost reduction in all application areas. Cost reduction of commercial and DoD products could improve market sales of U.S. products in foreign markets.

Reference Data Bases:
1. Solid Propulsion Integrity Program (SPIP).
2. Smart processing of polymer matrix composites.

KEYWORDS: tape-wrapped carbon-phenolic, polymer matrix composites, fabrication techniques, cost reduction, automated processing, smart processing

N98-074 TITLE: Development of Low-Cost X-band T/R Modules with Commercial Off-the-Shelf Components.

OBJECTIVE: Design, Develop, and Demonstrate low cost X-band T/R modules using commercial off-the-components.

DESCRIPTION: The goal of the task is to develop low cost X-band T/R modules with commercial off-the-shelf (COTS) components. The modules should have a peak power near 8W, a duty cycle of 25%, and an operating bandwidth greater than 2.5 GHz. The target cost of the module components and packaging, when purchased in production quantities, is less than $500.

PHASE I: Develop a module design that meets the above requirements. Identify COTS components and determine the estimated production cost of the module components.

PHASE II: Produce five modules specified by the design created in Phase I. Demonstrate transmit power and bandwidth performance.

PHASE III: Work with the government to transition the low cost module design to industry for use with potential Department of Defense or Federal Aviation Administration surveillance radars.

COMMERCIAL POTENTIAL: The module development has potential private sector applications in the satellite and communications industry. Contractors developing X-band components for communications applications will benefit from the transfer of technology.

KEY WORDS: T/R Modules; X-band; Lost cost; COTS

N98-075 TITLE: Low Cost Manufacturing of Lightweight Resin-Matrix Composites

OBJECTIVE: Development of advanced techniques and methods of formulating and fabricating Electroset resin matrix composites that are low cost, lightweight and high modulus.

DESCRIPTION: Lightweight materials such as fiber-reinforced composites offer the ability to fabricate minimum weight structures capable of withstanding high-g loading, and the acoustic and thermal environment of surface to air missiles. Missile components must withstand aerothermal heating, structural vibration and high g loads. Lightweight composite materials are beneficial for such applications.
New Electroset Resins have been discovered that can be electrically cured. The Navy seeks to exploit this unique method of curing to develop low cost, lightweight structural components. Electroset composite manufacture offers the following advantages: a.) fast electrical input heating, b.) highly energy efficient (nearly all of the resistance heating in the curing circuit occurs within the Electroset resin), c.) low capital investment cost. It also offers the means to manufacture and cure composites that are otherwise unproducible and/or unaffordable with thermal autoclave curing methods.
This solicitation seeks innovative approaches to develop the methodologies for manufacture of Electroset resin matrix composites of low cost missile components.

PHASE I: Develop methods of manufacturing resin-matrix composites using Electroset resins and electroset curing. Small scale subcomponents (i.e. sample coupons) shall be fabricated to demonstrate feasibility of the fabrication process and evaluated to provide the initial demonstration of structural integrity.

PHASE II: Develop the manufacturing methods for fabricating full size structural components. Full size structural components shall be designed, fabricated and tested to validate the manufacturing approach and to demonstrate the performance attainable from Electroset resin matrix composites.

PHASE III: Optimize the methods of Phase II and design composite components for performance, cost, and producibility for use in Theatre Air Defense (TAD) missile systems to replace (or, at the very least, to be used in conjunction with) more costly composites in Navy weapon systems.

COMMERCIAL POTENTIAL: Commercial potential exists in a wide range of industries. Low cost Electroset composites will create new multi-million dollar markets for high performance composites in commodity type products where cost is the driver. (Due to their current expense, high performance composites are only used in premium cost products.) Electroset composites can enable greater use of composites in commercial buses, trains, trucks and automobiles thereby realizing cost savings due to significant weight savings and improved fuel efficiency. Electroset curing methods will enable application to an array of economical consumer products from lightweight appliances (power tools) and medical equipment (lightweight wheel chairs) to sports equipment (bicycles, tennis rackets, etc.). Another market exists for composite building components such as corrosion free, long life, lightweight columns and beams.

REFERENCES: U.S. Patent 5,518,664, entitled "Programmable

Electroset Processes". The Navy is not asserting any proprietary rights and benefits on this patent in connection with this SBIR topic. This patent will be furnished as government furnished information to successful bidders, and is available from the United States Patent Office.

KEY WORDS: Manufacturing; composites; lightweight; affordable; Electroset; resin-matrix;

N98-076 TITLE: Improvements in Microwave Power Modules

OBJECTIVE: Develop a novel Microwave Power Module (MPM) design which improve the weight, size, efficiency, and/or thermal operating characteristics of state of the art MPM technologies.

DESCRIPTION: Current Antenna designs based on solid state Transmit/Receive (T/R) Modules are heavy and require liquid-cooling due to poor thermal operating characteristics. Improved antenna characteristics may result by incorporating advanced MPM technologies in place of T/R Module designs. In order to anticipate the next wave of MPM technologies which can provide step improvement in antenna size and weights, we require novel MPM technology to achieve sufficient thermal efficiencies that future antennas can be air-cooled. This will lead to reductions in antenna sizes and/or weights. Additionally, increased efficiencies are sought for MPMs which can be readily associated with related size and weight reductions. Achievement of thermal properties within MPM designs to allow for air-cooling is sought as well.
PHASE I: During this phase, a design for a novel MPM device will be developed. Sufficient aspects of the MPM design will be modeled and analyzed with computational analysis to demonstrate potential performance. Laboratory tests will be conducted to demonstrate thermal characteristics of designs which promise thermal operation improvements.
PHASE II: During this phase a prototype for the design analyzed in phase 1 will be built and tested to demonstrate efficiencies and thermal characteristics.
PHASE III: Military application and commercialization will be pursued in this phase.

COMMERCIAL POTENTIAL: MPMs with step improvements in size and weight as well as better thermal operating characteristics are attractive to many RF devices including commercial radar, communications, traffic safety, measurement sensoring, and security devices. Application to satellite communications is particularly promising due to the projected high demand for smaller and lighter communication payloads.

KEY WORDS: microwave, module, MPM, antenna, thermal

N98-077 TITLE: A Multi-Level Network (MLN) Approach to Theater Battle Management Operations

OBJECTIVE: Design a Multi-Level Network (MLN) to leverage existing sensors and battle management platforms in a stacked and branched open architecture network.

DESCRIPTION: The Multi-Level Network (MLN) is an approach to leverage use of existing sensors and battle management platforms in a stacked and branched network. Existing Command and Control platforms (AEGIS, E2C, AWACS) would serve as gateways between distributive networks, the sensor network, and the tactical information network. These networks would function independently, but share data and commands as needed. The MLN should link the sensor platforms to existing battle management platforms and to the shooters.

PHASE I: Define the Multi-Level Network capabilities, attainable with present sensors and data link, within the various TAMD mission areas. Estimate improved MLN capabilities with the addition of CEC-like data distribution and fusion. As a result of this analysis, develop an open sensor/BMC3 architecture and concept of operations that would be scalable as additional assets deployed to the developing theater.

PHASE II: Develop and demonstrate a prototype implementation of the open MLN. Show how sensor to shooter timeliness can be compressed through the use of multiple sensors netted together via CEC-like data distribution with connectivity to existing command and control platforms and data links to shooters (F/A-18).

PHASE III: Integration of the prototype architecture and technology into the designated sensor platforms and battle management systems.

COMMERCIAL POTENTIAL: Numerous commercial industries rely upon the efficient utilization of available communications band-with. Techniques and technology will be developed under this SBIR that will have broad application in telecommunications, broadcast television, cable TV and corporate inter/intranet

KEY WORDS: Cooperative Engagement Capability (CEC); Joint Maritime Command Information System (JMCIS); Theater Ballistic Missile Defense; TADIL J; BMC4I; Airborne Platforms.

N98-078 TITLE: Compact High Energy Infrared Laser

OBJECTIVE: Develop a compact, high energy, pulsed infrared laser that operates in the 3 - 5 micron and 8 - 12 micron spectral bands.

DESCRIPTION: Develop and prototype compact, low repetition rate (up to 10 Hz), 1 - 10 microsecond pulse-width, greater than 1,000 Joule/pulse lasers in both the 3 - 5 micron (MWIR) and 8 - 12 micron (LWIR) spectral bands to support ongoing development of electro-optical systems. The laser output shall have good atmospheric transmission and the mode quality shall not exceed 2 times diffraction limited.

PHASE I: Investigate the feasibility and demonstrate supporting technologies of a compact, pulsed, high energy 3 - 12 micron laser meeting the energy, wavelength and beam

quality requirements. Resolve relevant beam divergence issues. Address design, performance, and operational safety issues of a system to be fabricated in Phase II as well as laser energy scaling issues in achieving the required output energy and repetition rate.
PHASE II: Design, fabricate, test, and deliver a laboratory brassboard, 1,000 Joule/pulse, 1 - 10 microsecond pulse-width, single shot to 10 Hz prf, MWIR and LWIR laser system. Laser head shall fit on a desk top.
PHASE III: Transition technology to develop a highly compact and ruggedized systems for military and commercial applications.

COMMERCIAL POTENTIAL: The wavelength and output energy of this technology is needed for the detection of environmental pollution where the path lengths are greater than 20 km and/or large areas or volumes of atmosphere are monitored.

KEY WORDS: Lasers; mid-wave infrared; long-wave infrared; high energy; pulsed; low repetition rate.

N98-079 TITLE: PCMCIA Card to Collect/Store Vibration/Performance Data for Operating Machinery.

OBJECTIVE: Develop a PCMCIA vibration/performance card compatible with and operational in a Lap Top personal Computer in order to acquire, store, display and screen field-collected data from operating machinery.

DESCRIPTION: The PCMCIA card should facilitate machinery condition monitoring by enabling the acquisition and storage of vibration spectra as well as other condition assessment parameters with a minimum of operator expertise and intervention. Key features of the PCMCIA card must include the following:
- Wide range input preamplifiers with auto range capability for up to six charge-mode and voltage-modeaccelerometer inputs.
- On-board integration and scaling of acceleration signal to vibration velocity.
- Buffered signal monitor output for both pre- and post-integrator (i.e. acceleration and velocity) analog signals.
- Tachometer signal input provisions.
- On-board FFT processing capability with password protected options of 400, 800 or 1600 line resolution and ensemble averaging.
- Capability to compute order-normalized (tracked) spectra based on setting analysis sampling rate proportional to actual machine speed, with or without an external tachometer signal.
- Data validation features including overload indicators, internal self-test hardware, and error-detection software.
- On-board non-volatile storage capacity for at least 2000 FFT spectra and broadband levels.
- Stored data integrity that must be maintained for a period of at least 7 days with no external power connected. In addition, the data must be protected and remain retrievable even with a program "crash".
- Storage of measurement location identifiers and operating

condition parameters linked to each spectrum.
- Menu-driven operating software with display of operator prompts.
- User-defined route to direct data acquisition without additional inputs.
- Built-in serial interface and software providing capability for both local and remote communication with host computer.
- Built-in display software for readout of broadband vibration velocity level in VdB units (re 10^-8 m/sec) and display of operator prompts, as well as display of spectrum data in bar graph format.
- Should be designed around some type of standards based open architecture (such as MIMOSA) for interfacing/communicating with many different databases and Condition Based Maintenance (CBM) systems (including AEC, ICAS and commercial systems).

PHASE I: Develop concepts and methods, and a preliminary design for a PCMCIA card that will acquire, store, and to facilitate display and screening of vibration/performance data as noted above.

PHASE II: Develop and fabricate a prototype PCMCIA card conforming to the Phase I preliminary design and including signal conditioning, FFT analysis/order tracking, screen displays, control software, card connections, and procedures as necessary to demonstrate the PCMCIA card performance and production potential to the Navy community.

PHASE III: Develop a production version of an operational PCMCIA vibration/performance card. Furnish a production-quality data collector card for testing and evaluation.

COMMERCIAL POTENTIAL: Vibration data collectors are becoming a standard in Navy and private industry CBM programs for the evaluation of machinery condition. Private industries with operating machinery such as power plants, and cruise ships would benefit from a PCMCIA vibration/performance card because in a large number of these programs, a separate data collector that interfaces with a PC/Laptop must be purchased and maintained. This card will fit into and communicate with any PC or Laptop computer and eliminate the need for this high cost separate specialized instrument. Therefore, developing a PCMCIA vibration/performance card will benefit private industry as well as the Navy.

KEY WORDS: vibration, performance, data, collector, maintenance, PCMCIA

N98-080 TITLE: Hover-Craft (LCAC) Vehicle Dynamics

OBJECTIVE: To develop a fully validated aerodynamics model for use in the Navy's Landing Craft Air Cushion (LCAC) Full Mission Trainer.

DESCRIPTION: A robust aerodynamics model does not currently exist for the LCAC due to the absence of validated flight test data for the vehicle. This deficiency is currently limiting the fidelity and training effectiveness of the LCAC Full Mission Trainer (FMT). Complex visual simulation of

dynamic open ocean and littoral features is now achievable, however training of LCAC pilots in a fully dynamic marine synthetic environment is not possible without a high fidelity LCAC aerodynamics model to support it. The purpose of this research is to gather the complete test data by taking measurements with the operational craft; and to perform experiments with the new model on the LCAC FMT.
PHASE I: Determine the flight data which must be collected, and the tests and logistics required in order to obtain the necessary data. Identify a methodology for integrating the developed model with the LCAC FMT in order to perform experiments.
PHASE II: Conduct the flight tests, analyze the data, develop the math model, code the model in software, validate the model, and integrate the new model with the existing LCAC FMT.
PHASE III: The validated models, software, and expertise developed under this contract will become the basis for commercial products to be sold as design tools to numerous manufactures of commercial and military (including foreign military) hovercraft, and for training simulations.

COMMERCIAL POTENTIAL: Hovercraft are now considered more cost-effective than conventional craft for several commercially important applications, e.g., shuttle services for transportation and tourism, transferring cargo in harbors and rivers, search and rescue operations, and for breaking up ice in navigable waterways. Hovercraft are also becoming increasingly popular for recreational use. There is a need for high fidelity simulation models, both for design and for validation of performance and safety characteristics of commercial hovercraft before they are approved for use.

KEY WORDS: LCAC; hover-craft; aerodynamics; vehicle dynamics; simulation.

N98-081 TITLE: Variable Virtual Combat Mock-up (VVCM)

OBJECTIVE: Develop innovative concepts and techniques for utilizing virtual reality Operator Machine Interfaces (OMI) for Combat System training.

DESCRIPTION: Recent developments in Navy shipboard training programs such as Battle Force Tactical Trainer (BFTT) have revolutionized the manner in which we train our crews in combat systems employment. BFTT utilizes advanced distributed modeling and simulation techniques in concert with a cognitive learning model to optimize team performance. There are occasions when shipboard training is not practical (Overhauls, Availabilities, New Construction) and crew proficiency training is still required to be conducted ashore. Current shore based solutions are cumbersome and costly. What is needed is a virtual CIC/CDC mock-up for team training purposes that is variable to each specific ship/class configuration. Shore based training scenarios could be run utilizing an S14A13 Tactical Advanced Simulated warfare Integrated Trainer (TASWIT) data base or other compatible, emulation-type, training software.

Sailors should be given the appearance of being physically located in their own CIC/CDC, at their own operator position during the course of a given scenario.
PHASE I: Research existing trainer architectures, Identify likely candidates, develop Training concept of operations and architecture for interactive utilization of selected trainers in a virtual OMI environment.
PHASE II: Develop a prototype virtual CIC/CDC Trainer demonstrating the openness of the chosen architecture, the ability to replicate multiple ship/configurations and conduct effective training.

PHASE III: Build upon the architecture developed and demonstrated in Phase I & II to develop and produce virtual CIC/CDC Trainers for New ship classes and apply the architecture to existing ships as a backfit program.

COMMERCIAL POTENTIAL: Many industries rely upon trainers to hone the skills of individuals operating within a team. Full scale mock ups of the operator stations can be extremely expensive to maintain and update to new configurations. Commercial power plants, Air Traffic Control, large manufacturing plants, ect. can benefit from this technology by establishing virtual operator stations for training.

KEY WORDS: Team Training; distributed simulation; virtual reality; open systems; reusable software; trainers

N98-082 TITLE: Reconfigurable Computing

OBJECTIVE: To develop a reconfigurable computing system using programmable gate arrays

DESCRIPTION: An Application Specific Integrated Circuit (ASIC) is found in all Commercial Off-The-Shelf (COTS) processors (i.e. Intel Pentium, HP PA-RISC, DEC Alpha, Sun Sparc). Each custom designed ASIC has gate densities that are typically 10 times that of programmable gate arrays. However, as gate densities continue to increase, it becomes feasible to apply programmable gate arrays in various computing applications now served with custom ASICs.
For example, programmable gate arrays have been successfully used to emulate the Reduced Instruction Set Computer (RISC) architecture typically found in a Digital Signal Processor (DSP). The use of a programmable gate array vice a specific DSP eliminates the hardware limitations of the DSP, and thus, readily supports enhancements of a design by emulating new DSP features in the same hardware. The capability to reconfigure the hardware logic to execute new software functions offers many benefits to the system designer and can provide a significant reduction in the cost of engineering changes.
The use of programmable gate arrays supports the reconfiguration of the hardware logic without the constraint of a single-purpose processor design. This feature permits the use of common hardware for multiple purposes and could eliminate the need for custom ASICs. Thus, the hardware for a reconfigurable computing system would be generic and only programmed when needed for a specific purpose. The

application of reconfigurable computing could dramatically reduce or eliminate the Navy's reliance on custom ASICs.
PHASE I: Develop a detailed architecture for a reconfigurable computing system using commercially available, programmable gate arrays.
PHASE II: Design, fabricate, test and demonstrate a prototype reconfigurable computing system by emulating two or more COTS processors and executing the same computer program compiled for operation on each of the target COTS processors demonstrated.
PHASE III: Fabricate and test production configurations of the reconfigurable computing system.

COMMERCIAL POTENTIAL: The use of a reconfigurable computing system has significant benefit in reducing obsolescence and in reducing the transition cost associated with changing from one COTS processor to another COTS processor. The commercial applications for reconfigurable computing include the potential replacement of most low-end COTS processors with programmable gate arrays. The potential for reconfigurable computing may also support new developments in commercial markets where "intelligent" processing is required, such as intelligent appliances, home security and the gaming industry.

KEY WORDS: Reconfigurable; Processor; Computing; Programmable; Gate; Arrays

N98-083 TITLE: Non-intrusive, non-mounting, non-contacting hand held Vibration Data collector, storage and analysis system for Operating Machinery

OBJECTIVE: To develop a non-intrusive, non-mounting, non-contacting system to collect, store and analyze vibration data from operating machinery.

DESCRIPTION: The field of vibration measurement can be significantly enhanced by the development of non-intrusive, non-mounting, non-contacting system (possibly utilizing laser, infrared or fiber optic technology) that retrieves, stores and analyzes vibration data for operating machinery. The sensor should facilitate machinery condition monitoring by enabling the acquisition and storage of vibration spectra from 10 - 10kHz, and amplitude range from 80 to 140 VdB re 10^-8 m/sec.amplitude range from 80 to 140 VdB re 10^-8 m/sec.

PHASE I: Show the feasibility of developing a non-intrusive, non-mounting, non-contacting system to collect, store and analyze vibration data from operating machinery. A detailed description of the method (such as laser, infrared, fiber optic or other technologies), discussion of the theoretical basis for operation, and your planned approach showing how this system will operate .
PHASE II: Focus on providing actual schematic diagrams, detailed drawings, technical and physical specifications for the method and the approach planned to be used. Demoinstrate a breadboard model.
PHASE III: Initiate manufacturing of model demonstrated in Phase II.

COMMERCIAL POTENTIAL: Acquiring vibration data for the evaluation of machinery condition is a standard in Navy and private industry CBM programs. Private industries with operating machinery such as power plants, and cruise ships would benefit from a non-intrusive, non-mounting, non-contacting vibration sensor because in a large number of these programs, a time consuming process is required for each machine to install an average of five vibration pads to accurately define the motion. A non-intrusive, non-mounting, non-contacting vibration sensor would reduce the amount of time needed to acquire vibration data. Currently, the Navy and private industry hardwire many sensor locations to acquire vibration data. This system would be able to greatly reduce this time. A person would be able to go to any machine, without installing any pads, point the sensor, and acquire vibration data. This system will also eliminate all of the possible errors normally associated with mounting fixtures, e.g. epoxy, grease, proper torque, machine bearing temperatures, etc.. Therefore, developing such a system will benefit private industry as well as the Navy.

KEY WORDS: vibration, hand-held, data, collector, maintenance, non-intrusive

N98-084 TITLE: Development of a Registration Mine Capability

OBJECTIVE: To improve the burial models (and their tactical utilization) and to validate them at sea, a capability is required which will allow the monitoring of mine burial (upon impact or upon longer term burial due to scour, etc.) and which will measure the environmental forcing functions responsible for the burial (e.g., currents).

DESCRIPTION: In expeditionary warfare, the ability to predict the likelihood of buried mines is critical to developing tactical options as well as MCM tactical decision making. Activities within NATO Mine Burial Specialist Team (MBST) and The Technical Cooperation Program (TTCP), as well as recent field trials, have made it clear that existing models are inadequate and/or have not been validated via sea tests. To improve the burial models (and their tactical utilization) and to validate them at sea, a capability is required which will allow the monitoring of mine burial (upon impact or upon longer term burial due to scour, etc.) and which will measure the environmental forcing functions responsible for the burial (e.g., currents). Outside of rudimentary capabilities by the Germans and Dutch, which measure degree of burial by optical means, this capability does not exist. Therefore, the objective of this effort is to develop a capability to measure mine burial over time and to concomitantly measure the environmental forces responsible for the burial. In addition, this capability, called a registration mine, will allow MCM operational testing and training for hunting partially buried mines. This capability must be flexible enough for use with virtually any mine shape and suitable for measuring all relevant environmental parameters and forces acting on the mine. This will negate the requirement for a specially built registration mine for each mine shape of interest (cylindrical, bomb, truncated cone, etc.). There are essentially two primary military uses for this capability. Firstly, mine burial can be monitored over time, and the degree of burial can be related to the environmental forces responsible for the burial. This information will allow verification of mine burial prediction models and can lead to significant improvements in mine burial prediction capabilities. Secondly, once the mine is partially buried, the sensor package would determine the exact amount of burial and mine orientation. This information is critical for training and in the evaluation of the capabilities of our MCM forces to hunt partially buried mines.

The burial/sensor capability to be designed and built under this topic would be attached either conformally to or internally within the mine shape. In either case, the sensor package must have minimal impact on the environmental forces driving mine burial, must be able to function in any orientation and attitude, and must preserve the gravity, weight, and target strength of an operationally configured mine. The effort requires three phases:

PHASE I: The contractor would be expected to develop and finalize an optimum design of the sensor package. A significant design consideration is that the mine shape must fall from a ship, through the water column, and impact the sea floor. The design to be provided will require attachment method, candidate sensors, and data storage, display, and retrieval. The design effort will require some hardware research for selecting materials and electronics as well as verifying concepts.Projected Sensor Package Requirements:

- Configuration suitable for installation on/in two mine shapes cylinder and truncated cone. Built in growth potential with additional analog data channels for future sensors
- Selectable process control parameters (start/end data, sample interval, etc.)
- Power for 3 month operations with sampling every hour
- Memory and data not lost with power loss
- Data retrievable using typical spread sheet program on a lap top computer

- Lifetime of 15 years with life cycle costs minimized
- Depth to 200 meters
- Nonproprietary software to allow for future development of the package.
- Data capabilities required; time series measurements over a three month period; a single sensor type (e.g., acoustic) for % burial, water currents, sediment transport, acoustic energy; mine attitude on the bottom; mine orientation; a seismic sensor for local forces (burial due to shakedown/liquefaction); water depth

System Description: The sensor package, as a minimum, should consist of the sensor package module, the data acquisition and data storage module, a battery power module, and any associated equipment needed for deployment in and/or attachment to the two mine shapes. Data retrieval, display, and analysis will typically be done on ship, using a commercially available spreadsheet type program, following an in water deployment of the package. Modules can be

integrated or separated; however, the requirement mandates that size and shape of the sensor package be as small as is possible so that its impact on the environmental conditions is minimized. A typical operation with the package would include deployment by falling through the water column onto or into a sea floor varying from soft mud to hard sand, followed by up to three months (i.e., several tidal cycles) on/in the sea floor. During that period, the package would be exposed to a variety of mine burial processes in water depths as shallow as 10 feet and as deep as 200 feet. Wave action, and associated forces, are likely to be significant.
PHASE II: The contractor will build two (2) system prototypes for test. Equipment supplied by the contractor will include: sensor package, power, and data storage, retrieval, and display systems. A field test of the sensor package will be required using two target shapes, a cylinder and a truncated cone, for verifying versatility of the package. Mine shapes will be government supplied.
PHASE III: For final acceptance, the contractor will participate in two full up field demonstrations of the registration mine sensor package. Each field test will require 5 to 7 day sea tests using a commercial research vessel or an operational navy ship.

COMMERCIAL POTENTIAL: The sensor system has both foreign military and commercial sale potential. Interest in this type of capability has been shown by the United Kingdom (Defence Research Agency) and Australian (Defence Science & Technology Organization) for use by their naval forces in training and assessment of mine burial models. Additionally, the package could be used commercially to determine the suitability of the sea floor for burial of objects such as moorings, platforms, and pipelines that are placed on the sea floor. It would therefore be used in any application that needs to know the suitability of the sea floor for supporting objects/structures. The package can also be used to provide environmental monitoring of baseline conditions and changes within an area of interest. Thus, it is suitable for use in a wide variety of applications in environmental survey (i.e., environmental impact or site selection) and monitoring.

KEY WORDS: Mine Burial; Mine Burial Modeling; Environmental Measurements; Mine Burial Sensor; Mine Countermeasures; MCM; Environmental Parameters

N98-085 TITLE: Virtual Integrated Engineering Data Extraction Environment

OBJECTIVE: To develop an internet data extraction capability by extracting engineering information from a disparate and geographically dispersed heterogeneous set of ship engineering databases.

DESCRIPTION: Current ship engineering efforts for new ship construction and inservice alterations require a large and varied quantity of multi-source data from organizational distinctive and geographically separated databases or "data warehouses". The numerous heterogenous databases and their data views are used to create an integrated ship data

environment that supports and includes: operational concept formulation, modeling, analysis and validation; design and interface performance specification; contractual statements of requirements generation; logistics and management resource planning and scheduling. These data sources stretch across unclassified and classified databases implemented on various computing hardware and database management systems to implement: (JCF), Fleet Installation Planning and Programming System (FMPFIS), Shipboard Warfighting Improvement Program (WIPX), Surface Ship Combat System Master Plan (SSCSMP), (SEMCIP), (CSCADES). The demand for data from those databases relies on manual search, query, extraction, aggregation and post-retrieval storage techniques which is both inefficient and costly. An automated, integrated ship engineering data environment is needed. In this environment, the user will create a particular engineering data schema or "view" accessing and retrieving data from the various database sites and their associated data warehouses. The user can browse the databases to create a particular data schema. This enables the user to define, evaluate and assess newly created data relations and to validate hypotheses and establish "new" relationships. The effort's by-product enables one to perform data mining" from the engineering data "cyber space", represented by the existent ship engineering data warehouses, to create an integrated virtual data representation of the ship.
PHASE I: Perform analysis of the "data warehouse" environment for existent ship engineering data bases, determine their interrelationships and interdependencies, and establish feasibility of linkages and data extraction.

PHASE II: Develop prototype "data mining" extraction system exploiting the internet to browse and extract engineering information from multi-source data environments to create "new" virtual data views for use in formulating and validating ship operation concept, ship performance and interface specification, contractual requirements generation, support requirements, and managing resources and scheduling.
PHASE III: Produce user friendly "data mining" extraction system and tools tailored for use in each commercial business sector.

COMMERCIAL POTENTIAL: The development of the sought capability for "data mining" and "virtual" database generation has significant promise for commercial use where integrated engineering data environments would have application in designing, developing and implementing large or complex systems, such as: commercial aircraft, vehicles, buildings, manufacturing plants and communication systems. Commercial engineering data and models from diverse fields, such as architectural engineering; mechanical engineering; aero-nautical engineering; environmental engineering; and ocean engineering-created by various business sectors produced by different commercial entities-are being brought together to better understand the systems by discovering the interdependencies between system elements. For example, an aircraft producer/designer/integrator, such as Boeing Aircraft, relies upon its first, second and third tier suppliers/vendors to provide it the systems, sub-systems and components need for the aircraft. Those suppliers/vendors possess unique and distributed databases that capture various information aspects about their products. Through a virtual database integration capability, Boeing is able to iteratively model, study and examine a prospective aircraft's design, performance, logistics support and costs associated with its constituent elements from several aircraft engineering design and business perspectives in performing an engineering and production trade analysis.

REFERENCES: Common Object Request Broker Architecture (CORBA), Distributed Common Object Model (DCOM), JAVA Database Connectivity (JDBC), Open Object Database Connectivity (ODBC).

KEYWORDS: Internet, data mining, data warehousing, database, object model, programming.

N98-086 TITLE: Cleaners for Wastewater Ultrafiltration Membranes

OBJECTIVE: Development of a non-polluting cleaning technology for removal of clogging buildups and/or microbial fouling from ultrafiltration membranes used in treatment of non-oily wastewater (graywater/blackwater) on surface ships.

DESCRIPTION: New technologies for treatment of non-oily liquid wastes produce by Navy surface ships are being developed in Navy laboratories. These technologies are designed for removal of microorganisms, particles and organic material from the waste stream in order to meet regulatory standards for discharge of treated water into the ocean. Liquid wastes that will be treated with these new systems include graywater (shower, laundry and galley wastes) and mixtures of graywater and blackwater (toilet wastes). During operation of the treatment systems, ultrafiltration membranes gradually foul and become partially clogged with waste buildup or microbial biofilms, leading to reduced performance and, eventually, to failures in meeting regulatory standards. This effort would lead to development of innovative, safe, non-polluting cleaning technologies (for continuous or periodic cleaning) targeted specifically toward the kinds of fouling found in or on ultrafiltration membranes processing shipboard graywater/blackwater wastes.

PHASE I: Develop a design for and demonstrate feasibility of a cleaning technology appropriate for removal of fouling and clogs from shipboard waste treatment filter membranes. The design should consider the type(s) of fouling encountered, compatibility with membrane and other treatment system materials, and requirement for non-interference with treatment system performance or effluent quality.

PHASE II: Develop and test a cleaning system, based on the technology used in Phase I, that can be incorporated into a bioreactor/membrane ultrafiltration wastewater treatment system for use on ships. The cleaning system should be evaluated for efficacy, safety, ease of use, and compatibility with the overall wastewater treatment system.

PHASE III: Manufacture, delivery and evaluation of membrane cleaning systems for installation on ships equipped with ultrafiltration membrane reactor systems.

COMMERCIAL POTENTIAL: Ultrafiltration membranes are used increasingly in treating a variety of liquid waste streams in industry, government, and public/municipal operations-both on land and abroad commercial and other non-military vessels. Fouling of membranes is a difficult problem in many of these applications. The technology developed here could be applied to any membrane ultrafiltration system.

REFERENCES: "Graywater Characterization," Mary C. Whelan, DTRC Report TM-28-89-01 (1989).

KEYWORDS: Cleaning, ultrafiltration, fouling, enzymes, wastewater, membranes

N98-087   TITLE: Modulated Scattering Technique (MST) Field Probe Array System (FPAS) for Rapid Near-Field Measurements of Antennas and Composite Walls

OBJECTIVE: Design and develop an innovative transportable Field Probe Array System (FPAS) based on the Modulated Scattering Technique (MST) to make fast, accurate Near-Field(NF) measurements of a) Navy microwave antenna radiation and b) composite wall transmission and reflection coefficients. The MST/FPAS should also provide the Near-Field/Far-Field transformation software for computing antenna patterns based on the Spherical Angular Function (SAF) technique for use in such shipboard antenna analysis codes as GMULT, GLOSS, and GCUPL, and the Near-Field diagnostic imaging codes for imaging the interior of topside composite walls.

DESCRIPTION: SAF computer codes for predicting shipboard antenna performances are continuing to be developed. Future ships will increasingly utilize antennas that are either enclosed or embedded in composite structures. It will be necessary to have accurate SAF data for current and future antennas that must also be able to rapidly assess the composite wall electromagnetic performances over surface areas that are both physically and electrically large during the entire operational life cycle. NF measurements of the antennas and composite walls are required in order to derive accurate SAFs and to accurately determine composite wall reflection/transmission performances at in-band and out-of band frequencies. Unfortunately, NF test systems that employ mechanical scanning in two dimensions can require many hours to scan the antennas and composite wall areas of interest for this application, and they are typically not suited for shipboard use.
Recent efforts concerning rapid NF measurement technology based on MST probe arrays appear to be promising for development of economical transportable NF measurement systems that can be used either in dedicated indoor test chambers or onboard ship. The requisite NF data can be acquired in a few seconds or minutes by electronically scanning along the probe array length and mechanically scanning in the orthogonal direction. MST probe array systems use low frequency multiplexing to address the probe elements, thereby avoiding the expense and reliability

problems associated with microwave switches employed in conventional phased array systems technology. Research conducted under controlled research laboratory conditions show that reductions of 95 percent, or more in the NF measurement time for antenna testing can be achieved by using MST probe array systems as compared to conventional mechanical scanning in two dimensions. However, further innovation and development is necessary in order to derive cost-effective broadband, dual-polarized, transportable MST probe array systems for shipboard antenna and composite wall applications under realistic operating conditions.

PHASE I: Perform a preliminary design study to assess and demonstrate the technical feasibility of the proposed NF measurement technique. Design the transportable MST/FPAS for rapid NF testing in the 0.9 GHz to 4.0 GHz frequency band. Design the system to measure two orthogonal polarization states over the designated frequency band. Perform analyses and numerical simulations 1) to determine probe array spacing and number of probe elements, 2) to assess candidate probe array feed systems, 3) to determine the achievable probe element VSWR, insertion losses, backscatter, and cross-polarization characteristics, and 4) assess the performance envelopes of the MST probe array system for NF testing of antennas and composite walls. Describe and demonstrate the NF transformation and NF diagnostic testing software that will be used to process the measured NF data, and identify any needed improvements that will be implemented in Phase II to meet accuracy specifications.

PHASE II: Perform the detailed design and development of the MST/FPAS based on the results of Phase I and additional advanced engineering design and development work specific to the implementation of an operational transportable prototype. The prototype shall operate dual-polarized in the 0.9 GHz to 4.0 GHz frequency band. Demonstrate the MST/FPAS prototype hardware and software for rapid NF measurements of two selected Navy microwave antennas and composite walls.

PHASE III: Implement and demonstrate advanced MST/FPAS's for rapid NF measurement of antennas and composite walls in 1) the 4.0 GHz to 12 GHz frequency range and 2) the 12 GHz to 24 GHz frequency range.

COMMERCIAL POTENTIAL: Potential commercial applications of this technology include near-field testing of telecommunication antennas and airport surveillance radars, near-field radome testing for commercial aircraft, near-field EMC testing, non-destructive testing of multilayer composite industrial materials, paper and wood products, control of commercial microwave drying processes, imaging of buried objects such as concrete reinforcing bars, pipes, cables, and drugs/weapons caches, and microwave hydrology.

REFERENCES:
1. B.J.Cown, J.P.Estrada, Ph. Garreau, D.Picard, and J. CH. Bolomey, "Efficient Near-Field Measurements of Antennas, Radomes, and Scattering Targets via the Modulated Scattering Technique", 1996 AMTA Symposium Proceedings, Seattle, WA, Sept 30 - Oct 3, 1996
2. B. J. Cown and J. P. Estrada "MST Portable Near-Field Antenna Measurement System Study", Final Technical Report, GTRI and GEMTECH, U.S. Army Contract No. DAAB07-88-K-A020,

December, 1995.
3. B.J. Cown, et. al.,"Advanced MST Automated Electromagnetic Field Probe for Anechoic Chamber Testing, Final Technical Report, SATIMO Project SIA-9602, Contract F04611-96-C-0060, March 27, 1997.

4. Barry J. Cown,et.al., "Fast Anechoic Chamber Diagnostic Testing via Modulated Scattering Arrays and the MUSIC Imaging Code", 1997 IEEE/URSI Meeting Digest, Montreal, Canada, July 13-18, 1997.

KEY WORDS: MST probe arrays, Near-field antennas, Composite

N98-088 TITLE: Co-Infusion of Multiple Resin Systems Through the Thickness for Composites Structures with Enhanced Fire Performance

OBJECTIVE: Develop a low cost fabrication process capable of co-infiltrating a composite fiber preform with a two distinct resin systems such as or vinyl ester and phenolic using a resin transfer molding technique to achieve a low cost fire tolerant composite structure in a single manufacturing step.

DESCRIPTION: The constituent elements of a composite material are typically chosen to achieve specific mechanical attributes. The fibers are chosen for their stiffness or strength, i.e. mechanical properties, and the resin is chosen for its environmental requirement, cost, or processability. To provide appropriate fire tolerant composite structures, secondary manufacturing steps are normally required where additional layers of material are added to the composite surface which provide enhanced fire performance. A process which would manufacture the total system with both matrix materials in a single step process would save both money and time and would produce a more survivable system. This effort would use resin systems which are of interest by the Navy to develop a processing technique which could produce low cost hybrid matrix composites with two distinct resin systems through the thicknesses.
PHASE I: Develop and demonstrate experimentally a method for simultaneously infiltrating a dry fiber preform with two distinct resin systems such as vinylester and phenolic having distinct resin fronts through the thickness The fabrication method should be one that can be scaled up to large parts, i.e. areal dimensions of 10 ft. x 10 ft minimum, and which is low cost such as a some variant of the VARTM process.
PHASE II: Identify primary structural application and design and manufacture a large scale component (1/2 scale) which requires the dual resin system such as a composite deck house with integral fire barrier. Perform mechanical integrity tests and fire performance studies on fabricated structure.
PHASE III: Manufacture large scale hull component. Develop complete data base on material system including low temperature, elevated temperature and moisture conditioned properties.

COMMERCIAL POTENTIAL: This type of system could be utilized in numerous industrial applications where low cost fire tolerant composite systems are required. Such applications include bridge structures rehabilitation, cruise ships, internal aircraft structures (cabin/bulkhead) and submersible applications.

KEY WORDS: co-infusion, fire, damping, VARTM, low cost

N98-089 TITLE: Development of a Low Cost Process to Provide Improved Carbon Fiber-Vinyl Ester Adhesion

OBJECTIVE: Develop a process/material modification for carbon fiber/ vinyl ester composite materials which will provide enhanced fiber-matrix adhesion using a low cost, room temperature manufacturing process such as vacuum assisted resin transfer for high performance composite structures. This level of adhesion should be comparable to carbon-epoxy. One test method to measure the affectiveness of an improved adhesion is through a transverse tensile test, where these strengths should approach that of the resin material. These values should be for both as processed and saturated conditions. Current values are anywhere from approximately 50% for as processed to 25% for saturated conditions of the desired transverse tensile strength.

DESCRIPTION: Carbon fiber composite materials are typically high cost materials because of the basic material costs, as well as the manufacturing costs. One way to reduce the cost of carbon fiber composite structures would be to utilize low cost material forms, such as heavy weight fabrics, with a room temperature curing resin material such as vinyl ester. This combination of materials could then be used in a low cost fabrication method such as VARTM (vacuum assisted resin transfer molding process). This would provide the Navy with a low cost, high performance composite material which could be used for a primary structural material with high stiffness. Current vinyl ester/carbon combinations have not demonstrated adequate mechanical properties due to their poor fiber/matrix adhesion.

PHASE I: Develop and demonstrate experimentally a method for improving the fiber/matrix adhesion for carbon fiber broadgood materials with vinyl ester resin .

PHASE II: Identify primary structural application and design and manufacture a large scale component (1/2 scale). Develop material property data base required for design. Test the structural integrity of the part through laboratory/in-service testing.

PHASE III: Manufacture large scale hull component. Develop complete data base on material system including low temperature, elevated temperature and moisture conditioned properties.

COMMERCIAL POTENTIAL: This type of system could be utilized in numerous industrial applications where low cost high stiffness materials are needed. Such applications include bridge structures rehabilitation, high performance pleasure craft/racing yachts and other recreational equipment, and numerous aircraft structures.

KEYWORDS: interface, carbon fiber, vinyl ester, VARTM, low cost

N98-090 TITLE: Automated Mechanism for Transfer of Unclassified Information Residing in Secret Environments into Unclassified Environments Using Intermediate, Multi-Level Databases

OBJECTIVE: Provide greater capacity channels for transfer of otherwise Unclassified or Sensitive But Unclassified (SBU) engineering information originating in Secret environments to Unclassified or SBU environments for the purpose of translating and creating new and appropriate databases as needed.

DESCRIPTION: Modern engineering practices involve a wide range of data and data generating processes which reside in environments of different security classifications. In particular, some information developed by simulations in Secret environments must eventually feed back to engineering tasks that occur in Unclassified environments in order to incorporate certain types of design modifications. Although the information to be transferred would otherwise be Unclassified or SBU, the Secret environment within which the information has originated makes transfer of the information problematic. Existing solutions rely on low through put techniques such as e-mail based guard technology which also tend to depend on direct operator control to ensure security. This is a very manpower intensive and costly approach. What is needed is a higher capacity, secure technique which can provide a specific solution to the engineering design data feedback problem. There are two primary categories of threats that contribute to the complexity of general Hi to Low security environment transfers. First, the message content may camouflage classified information. For example, a 24 bit graphic image might carry an encoded message in portions of its data that do not visibly affect the image. Second, the timing of message traffic, especially from the Hi to Low side can be used to deduce information about the Hi security side. In addition to these two factors, general solutions are made more complex by the need to provide for simultaneous provision of data at multiple security levels.

PHASE I: This SBIR focuses specifically on the Secret to Unclassified / SBU transfer problem - retention of data in a Classified environment is unnecessary. It is expected that this stipulation will simplify the categorization and resolution of the involved threats. The first objective of Phase I is develop a taxonomy of those threats. A general characterization of the Hi to Low message content threat is that the outgoing data can act as a covert carrier for additional information. The second objective of Phase I is to examine and identify options which are available to reduce or eliminate additional message capacity. Message based methods for data transfer inherently involve the timing threat factor due to the general need for synchronous or asynchronous responses to confirm data transfer. Camouflaging of such confirmations may be more complex than

needed to support the specific functionality needed here. This SBIR focuses on the use of non-message based methods in order to minimize the timing threat. In particular, this research is to examine the feasibility of using a multi-level database with interfaces to both Unclassified and Secret environments as a means of "exposing" data in ways that reduce the involved threats. The third goal of Phase I is to identify and document the means by which such databases may be used to counter-act the timing threat factors. The fourth objective of Phase I is to evaluate current multi-level databases with respect to suitability, and to develop a specification, based on the findings of the first three objectives, for the programming of such a database to achieve the overall goal. The final objective of Phase I is to demonstrate feasibility with respect to existing multi-level database components.
PHASE II: The design developed during Phase I would be implemented within the context of a standalone workstation - the EMA / WS. This may involve verification of new multi-level features with respect to the DoD Trusted Computer System Evaluation Criteria (TCSEC) and will involve working with a designated approving authority to achieve approval of the solution.
PHASE III: The validated approach and components developed during Phase II will be extended to other Navy engineering environments, and a commercial version will be developed for private industry. The expected result would be an overall increase in the productivity of engineering activities involving Hi to Low data transfers, thereby decreasing design development time and reducing costs.

COMMERCIAL POTENTIAL: The proposed technology would benefit all efforts which involve transfer of low sensitivity information from Secret to Unclassified environments. It is also expected that the developed techniques may offer an alternate approach to security for private industry concerned with controlled exposure of public or less sensitive data which is integrated with and stored with sensitive data such as the banking and credit reporting industry.

KEY WORDS: Trusted multi-level database; Guard technology; Message capacity;

N98-091 TITLE: Quieting Inflow to Enclosed Impellers and/or Open Field Propellers for Acoustic Silencing

OBJECTIVE: The objective is to obtain quieter propulsors by utilizing annular flow conditioning to obtain quieter and more efficient propulsors for US Navy vessels.

DESCRIPTION: Turbulent flow into enclosed impellers/open field propellers generates propulsor inefficiencies which results in increased noise levels. Reducing the turbulent with annular devices prior to the propulsor will result in a more efficient and quieter impeller/propeller.
PHASE I: Phase I will investigate annular inflow control and the potential hydroacoustic and efficiency benefits. Model acoustic testing to confirm the potential of this

silencing technology will be conducted.
PHASE II: Phase II will be the construction of larger scale models for acoustic and hydrodynamic testing and validation in test tanks/flow facilities (water tunnels). Full documentation in report format clearly demonstrating acoustic noise reductions and hydrodynamic effects in terms of efficiency changes.
PHASE III: The completion of Phase II will have clearly demonstrated acoustic improvements and the hydrodynamic effects of annular flow control techniques for transition to Phase III. During Phase III, the offeror shall develop a large scale flow control device for installation on a large scale model and/or small ship. This device will be tested in accordance with current Navy acoustic programs. The Navy will provide access to such a vehicle/ship for this project.

COMMERCIAL POTENTIAL: The commercial application of propulsor silencing is applicable to the commercial fishing industry, and the sport boat industry. The envisioned device will reduce acoustic noise in the water, which is disruptive to marine life. The utilization of quiet propulsors will yield more accurate research studies on marine life.

KEYWORDS: Acoustics; propellers; impellers; silencing; quiet; annular flow control

N98-092 TITLE: Shipboard Airborne Noise Control Design and Diagnostic Tool

OBJECTIVE: To effectively incorporate airborne noise and vibration control in the overall ship design and construction process to improve airborne noise and vibration environment on all vessels while reducing the associated adverse impacts on space, weight, maintainability of systems and cost.

DESCRIPTION: The current shipboard airborne noise control design guide is outdated and does not accurately handle non-conventional hull types or design features and can only be used effectively by acoustics engineers. The objective is to develop a computerized noise prediction and analysis tool that will utilize the latest technology and methods to accurately handle various airborne noise control issues. This tool will run on PCs and will be used by any non-acoustics engineers to perform various design trade-off studies, as well as by acoustics engineers for more in-depth analysis.
PHASE I: Develop an overall scheme and methods for the task. Identify all the resources (expertise in shipboard acoustics and computer programming) to be used for this task. Develop a detailed logic scheme for the computer programs and select prediction algorithms. Establish input/output methods and formats.
PHASE II: Compose algorithms for various elements of the prediction procedures and complete the overall computer program that meets the above description. Test this program on a ship with measured noise deficiencies to test the programs accuracy and then to use the program to recommend appropriate corrective actions for the measured noise

deficiencies. Develop a user's manual.
PHASE III: Use the program on a new ship program for noise predictions, then make modifications as necessary after verifying the accuracy of the predicted results against actual measurements. Develop interface for various databases to be used with the program.

COMMERCIAL POTENTIAL: This program can be used as an airborne noise control design tool by any commercial shipbuilding industry. The program is to be a comprehensive acoustic modeling tool that will include the latest noise prediction techniques and methods that can handle various hull types and sizes of ships so that any shipbuilding industry can greatly benefit from the capability of this tool in controlling the shipboard airborne noise. Not only the program will use the latest acoustic technology but also to utilize the computer programming techniques to build in the logic necessary to make the program user friendly so it can be used by people without acoustics background. The program is to be menu-driven and is to request the user all of the design information necessary to run the program.

REFERENCE: Society of Naval Architects and Marine Engineers (SNAME), Technical Research Bulletin 3-37, Design Guide for Shipboard Airborne Noise Control, Prepared by Fischer, R.W., Burroughs, C.B., Nelson, D.L., January 1991.

KEY WORDS: SNAME design guide update; airborne noise; shipboard habitability

N98-093 TITLE: Biofouling and Biocorrosion Monitor

OBJECTIVE: Develop a real-time sensor technology to detect microbial biofouling in seawater piping and cooling systems.

DESCRIPTION: The performance of shipboard piping and cooling systems is adversely affected by the formation of biofilms. Microbial fouling can lead to degradation of heat exchanger performance, promotion of macrofouling, and deterioration and failure of metals susceptible to microbiologically influenced corrosion (MIC). Chlorination commonly is used to mitigate biofouling and MIC in these systems. Chlorine demand from piping and cooling systems produces rapid decay of the free, available chlorine that is added, and underchlorination may result in inadequate biological control. Overchlorination, on the other hand, can produce excessive corrosion of pipe and tubing materials and also can lead to undesirable environmental impacts. On-line biofilm/biofouling sensors or monitoring technologies are sought that can provide information on whether biofouling control methods are performing adequately throughout a seawater piping/cooling system. Ultimately, use of such a sensor for automatic control optimization of chlorine or other biocide application is desired.
PHASE I: Design and demonstrate feasibility of a sensor technology that can monitor performance of biofouling control methods in seawater piping systems. The sensor should detect biological fouling specifically (as opposed to abiotic fouling) and have the potential for online, real-

time application. Microbiological tests must demonstrate that sensor output does indeed correlate with extent of biofouling. Contractor will deliver a report that includes design details and data that support feasibility for continued development.
PHASE II: Develop the sensor system for use as a real-time, on-line monitor of biocide effectiveness and test it in seawater piping test loops and/or in a shipboard simulation. Demonstrate its specificity for biological fouling and correlation with extent of fouling. Deliver a prototype sensor system and demonstrate its effectiveness when used with Navy materials and piping/heat exchanger designs. Develop and test a design for integrating the sensors into shipboard piping and cooling systems for automatic control of biocide application. Determine potential savings in terms of cost, biocide reduction, maintenance and labor.
PHASE III: With commercial partners, prepare, demonstrate and deliver a fully integrated, automated sensor/biocide control system for use in military and civilian piping and cooling systems. Install a system on a Navy vessel and evaluate its reliability, effectiveness, ease of use, compliance with environmental regulations, safety and cost savings.

COMMERCIAL POTENTIAL: An on-line biofouling monitoring technology would be useful to all users of cooling water who experience problems in system performance resulting from bio-film-induced degradation of thermal exchange or deterioration of materials due to MIC. This technology would also facilitate environmental compliance by preventing over-or-under application of biocides to cooling water.

REFERENCES:
(1) W.G. Characklis, B.J. Little, M.S. McGaughey, OBiofilms and their effect on local chemistry,O Microbial Corrosion: 1988 Workshop Proceedings, Electric Power Research Institute Report ER-6345, 1988.
(2) E.D. Thomas, K.E. Lucas, M.H. Peterson, D.K. Christianson, OEffects of chlorination on marine materials,O CORROSION/88, Paper No. 402.
(3) G. Ventura, E. Traverso, A. Mollica, OEffect of NaCIO biocide additions in natural seawater on stainless steel corrosion resistance,O Corrosion 45(4):319.
(4) B. Wallen, S. Henrikson, OEffect of chlorination on stainless steels in seawater,O CORROSION/88, Paper No. 403.

KEYWORDS: Biofouling, biofilm, chlorination, microbiologically influenced corrosion, sensors, biodeterioration

N98-094 TITLE: Affordable High Performance Reinforced Polyurethane Shock and Vibration Mounts

OBJECTIVE: Develop a low cost multiple performance generic elastomeric machinery mount system which has varying static and dynamic vibration properties to provide vibration isolation over a wide operating load range. These mounts should be capable of meeting performance specifications for several mounts/load ranges as given in for example MIL-M-17185 (General Mount Spec.), MIL-M-17191 (P-Type Mounts), MIL-M 17508 (E-type Mounts), MIL-M-19379 (M-type Mounts), MIL-M-19863 (5B5000 Mounts) and MIL-M-21649 (5M10000 Mounts).

DESCRIPTION : Isolation mounts are used extensively on Navy ships to 1) reduce vibration noise from the hull to sensitive acoustic interrogation systems, and 2) to minimize the transmission of vibration energy of machinery to the ship hull. The Navy currently uses over 60 different types of mounts to provide vibration isolation for loads ranging from 0.5 lbs to 10,000 lbs. This program would seek to develop a generic mount configuration which could be utilized for a large range of load isolation requirements. Successful development of a single multiperformance mount will yield numerous benefits including reduction of inventoried items, reduction in costs associated with fewer parts fabricated, and standardization of installation and maintenance procedures.
PHASE I: Develop a system configuration which through analytical or experimental means exhibits potential for providing isolation for a significant range of loads. Identify configurational requirements that must be considered in developing an elastomeric multi-element system. Develop/Identify potential low cost fabrication methods for manufacturing the systems.
PHASE II: Transition analytical/experimental findings into prototype mount concepts for a family of mounts. Design, fabricate and characterize the static and dynamic properties of the prototype mount concepts. Fabricate associated hardware and conduct shock and vibration testing to assess performance. These shock and vibration requirements should be established with NAVSEA support. Provide prototype mounts for seatrials. Provide similar mounts for evaluation in industrial applications where vibration isolation from rotating equipment is required, particularly in harsh and corrosive environments.
PHASE III: Develop preliminary specifications for performance and mechanical requirements along with mount drawings for NAVSEA evaluation. Transition mounts to the fleet through installation of mounts for numerous fleet applications. Provide industry with range of mounts for vibration isolation of machinery components.

COMMERCIAL POTENTIAL: This type of system could be utilized in numerous industrial applications where noise and vibration are of concern. The potential use is very wide, which includes rotating and reciprocating equipment, isolation of precision equipment, as well as civil applications such as earthquake management.

REFERENCES: Rivera, Rimi O., "Non-metallic 15P150A Machinery Mounts", CARDIVNSWC-SSM-64-94-14, Aug 1994, 99p.

KEY WORDS: Mounts, reinforced polyurethane, vibration isolation, shock isolation, corrosion resistance

N98-095 TITLE: Red Phosphorous Powder Manufacturing Process

OBJECTIVE: The objective of this topic is to develop a means to produce red phosphorous powder suitable for incorporation into polymeric materials as a fire retardant.

DESCRIPTION: Hydrated metal oxides are commonly used as a fire retardant in some polymeric materials. Red phosphorous can provide superior fire suppression performance over other commonly available materials, but there currently are no production processes which can provide red phosphorous powder with the required attributes. This project concentrates on the development of a production process for making red phosphorous powder that with the appropriate properties for inclusion into polymer systems as a fire retardant.
PHASE I: Identify at least two new and innovative manufacturing processes for processing red phosphorous into a powder suitable for incorporation into polymer compounds. Concentrate investigations on processes that can produce grain sizes less than 5 microns and that inherently minimize the risk of explosion or fire. Compare the risks and benefits of the manufacturing processing identified and recommend one process for further development and validation. Develop a validation plan detailing the proposed manufacturing process, the initial process validation approaches, proposed process controls and equipment required.
PHASE II: Validate the capability of the process identified in Phase I to produce red phosphorous material with the appropriate grain sizes. Build a prototype red phosphorous processing station and develop detailed operations, quality control and safety procedures. Demonstrate the operation of the processing stations and provide sample quantities of processed red phosphorous to the government for evaluation.
PHASE III: Begin full scale production of the red phosphorous powder and begin supplying material to commercial polymer parts manufacturers.

COMMERCIAL POTENTIAL: The largest application of this product is in the commercial polymer materials and components market. The fire retardancy of polymer materials using this fire retardant may be an order of magnitude greater than that possible using currently available materials.

KEY WORDS: Material Processing; Red Phosphorous; Fire; Fire Retardant

N98-096 TITLE: Non-skid Surface Coatings for Navy Fleet Applications

OBJECTIVE: Develop non-skid coating systems with superior abrasion resistance, decreased life cycle cost, improved chemical and corrosion resistance, and resistance to cracking and spallation.

DESCRIPTION: Currently available non-skid coating systems (non-skid materials) used in the fleet (aircraft carriers, bridges, ordnance, etc.) are short lived and inadequate in performance. An example is their use on aircraft carrier decks where resistance to chemicals and corrosion is poor,

and cracking and spallation due to aircraft takeoffs and landings routinely occurs. The innovation goal of this effort is development of an entirely new non-skid coating system with improved life cycle performance and significantly increased mechanical, physical, and chemical properties.
PHASE I: Identify and/or formulate new non-skid coating systems. Modify as needed for optimum performance and perform bench scale tests to demonstrate their potential as coating systems which exceed the system requirement.
PHASE II: Establish new performance criteria for non-skid coatings. Select the more promising candidates from Phase I and conduct laboratory scale tests on selected substrates to compile a database on the critical physical, mechanical, and chemical properties of candidate non-skid systems. Based on the performance data developed in Phase II, prepare a preliminary modified MIL-PRF-24667A specification.
PHASE III: Under program office sponsorship conduct large scale tests on fleet systems and hardware to demonstrate that the performance goals identified in Phase 11 can meet field requirements. Commercial applications will also be identified.

COMMERCIAL POTENTIAL: Improved non-skid coatings systems can be applied to the commercial shipping industry, to improve overland transportation safety (non-skid roadways), and to recreational applications (swimming pool decks, tennis courts, etc.). Technology transfer to commercial applications will be encouraged during Phase III.

REFERENCES:
1. Neman, C., Shirley J., et al., "Penetration of a Chemical Agent Simulant into a Marine Non-skid Surface Coating"; Naval Research Laboratory, Washington, DC; May 15, 1987.
2. Kerrige, J., Zirkel, J., "Evaluation of USN Support Equipment for Use as Decontamination Vehicles; Naval Air Engineering Center, Lakehurst, NJ; December 31, 1990.

KEYWORDS: Coatings, non-skid materials, ship decks, cleaning, flight decks, decontamination

N98-097 TITLE: Fiber Optic Link Simulator

OBJECTIVE: The objective of this topic is to develop a fiber optic link simulation tools with a graphical user interface that allows standard fiber optic link analysis (per EIA/TIA-626 for multimode fiber systems) and which provides for optional link design analysis for multimode and single mode fiber systems with bit rates up to 10 gigabits per second.

DESCRIPTION: Fiber optic link analysis is currently a labor intensive effort that is implemented using custom built software or spreadsheets. Most link integrators and many link designers are not familiar with fiber optic communication link theory or how to calculate the effect of using different components on the performance of the link. A fiber optic link simulation tool is needed that will allow

a fiber optic link designer to design candidate fiber optic links and then simulate the loss, distortion, jitter and noise characteristics of those links. The simulator should minimally provide amplitude, noise, jitter, and distortion simulation for the fiber optic link. The simulator should also be able to display the transmitted signal at user selected points within the link, the eye pattern at user selected points within the link, the optical source output power versus current curve, and the receiver bit error ratio versus input power curve (for the defined link distortion).
PHASE I: Develop the simulator architecture description. Identify a basic set of components and those parameters that will be in each component's library file. Identify the analytical model(s) that will be used for each component. Develop a list of critical link parameters for the standard analysis and the more detailed analysis options.
PHASE II: Develop a simulator specification detailing the user interface attributes and the information flow and the internal program module interface attributes and information flow. Develop and validate (theoretically or experimentally) models for each components and models for the entire link. Develop and deliver a complete analysis program to the Navy.
PHASE III: Provide the software program to Navy and commercial designers and integrators.

COMMERCIAL POTENTIAL: The largest application of this product is in the commercial manufacture of local area network equipment. This application would be a invaluable to the government and commercial local are network design communities.

REFERENCES: EIA/TIA-626 "Fiber Optic Link Transmission Design."

KEYWORDS: Fiber Optics; Fiber Optic Link Design.

N98-098 TITLE: Injection Molded Ceramic Ferrules for Fiber Optic Connectors

OBJECTIVE: The objective of this topic is to develop an injection molding technique and production capability for ceramic ferrules for single mode fiber optic connector applications.

DESCRIPTION: Ceramic ferrules are used in over 95% of the single mode fiber optic connectors sold in the world. Current production methods are relatively expensive ($2 to $10 per ferrule depending upon quantity) and involve the production of ferrule blanks which are shaped to the final dimensions using numerous grinding and polishing operations. As an alternative method, injection molding techniques could be used to produce these parts without requiring many of the grinding and polishing operations. Typical injection molding processes are not sufficient due to problems in controlling the net shape of the molded part to the degree necessary (<0.5 micrometer tolerances on ferrule outer and inner diameters). An improved injection molding process is required which minimizes shrinkage during the curing of the green material and which minimizes the formation of voids

during the injection process.
PHASE I: Investigate and develop an optimized injection molding process for ceramic ferrules for single mode fiber optic connectors that will result in ferrule prices less than $1 per ferrule for relatively small quantities (10,000 pieces). Develop a manufacturing plan detailing the manufacturing process (and the process controls) and equipment required for mass production of the ferrules. Develop a working relationship with a major U.S. fiber optic connector manufacturer.

PHASE II: Build a prototype manufacturing line for the production of ceramic ferrules for single mode fiber optic connectors and a prototype test and measurement station for the measurement of critical ferrule parameters. Produce prototype ferrule samples and characterize the ferrules, investigating the effects of different ferrule formulations (binders, powders, etc) and different process control limits on the final ferrule quality. Determine if the molded ferrules will require final grinding and polishing to meet the dimensional tolerances required. Implement any final grinding or polishing operations into the prototype manufacturing line and produce and characterize manufacturing representative ferrule samples.

PHASE III: Begin full scale production of the ferrules and begin supplying ferrules to U.S. commercial fiber optic connector manufacturers.

COMMERCIAL POTENTIAL: The largest application of this product isin the commercial fiber optic connector market. Almost all fiberoptic ferrules used in the fiber optic connector industry are produced overseas. These ferrules are costly and can be limited in availability at times.

KEY WORDS: fiber optics, ferrules, connectors, single mode.

N98-099 TITLE: Dynamic Firing Zone for Weapon Systems

OBJECTIVE: Develop a Method of Providing a Real-time Dynamic Firing Zone Compatible with all Naval Weapon Systems.

DESCRIPTION: Firing zones for all U.S. Navy's weapon systems are static zones which are created from a CAD model and manually updated over a ship's lifecycle. The current highly manpower-intensive and costly method of updating requires routine ship check for physical verification of the topside configuration around the weapon system using bore sighting equipment. Then the CAD model must be updated to reflect the current topside configuration. This method of firing zone development and update can only be as accurate and current as the last physical verification; the typical firing zone update period is between two to four years. Another distinct disadvantage of the current method is that due to its static nature, this method is incapable of considering the movement of other major topside equipment such as other weapon systems, aircraft and helicopter operations, cranes, king posts and boat davits.

The main obstacle in providing a more-user friendly and less manpower-intensive, weapon system firing zone is in finding a method to automatically determine the actual physical environment around a weapon system without the need for constant physical verification through human interventions. One potential method may be to use high-resolution digital video technology to gather the initial two-dimensional bore sight image then to used a highly sophisticated computer vision algorithms to automatically decipher a three-dimensional image from the original two-dimensional video image. Another potential method may be to use very accurate, high speed sensors to acquire a three-dimensional composite picture of the physical surrounding around a weapon system.

PHASE I: Develop the conceptual approach and the detailed system design for a user-friendly and less manpower-intensive weapon system firing zone. Design the system, show feasibility, and report the progress, results and design as required.
PHASE II: Construct a prototype system capable of receiving digital image from the bore of a MK 45 5"/54 gun system. Test the accuracy with different ship motion characteristic associated with several different sea state conditions. In addition, test the high level image processing accuracy and time of the system with the introduction of several moving objects such as rotating crane, helicopters and missiles into the defined firing zone.
PHASE III: Modify design for full compatibility with all other naval weapon systems such as Rolling-Airframe-Missile (RAM) system, Nato SeaSparrow System (NSSM), and Close-In-Weapon System (CIWS). Optimize speed of the IPPR as well as the accuracy.

COMMERCIAL POTENTIAL: The main commercial applicability will be in the fields where high level image processing techniques are required such as automation of map making. Currently the maps required for geological purposes require level of accuracy to within 1 foot; this level of object discrimination can not be achieved using current image processing techniques and these video and film images have to be manually dissected for map making. The medical application is another field which requires extremely high level of accuracy; this is mainly due to the obvious life and death consequences involved when utilizing x-ray and MRI image processing techniques. High speed IPPR coupled with acceptable degree of accuracy would also greatly aid in factory automaton and/or robotics. Another commercial application area requiring advancement in IPPR would be in naval, airborne and automotive navigation including collision avoidance systems. Without the capability to accurately and automatically identify any moving or static object around a vessel, an automatic navigational system cannot be developed.

REFERENCES:
1. NAVSEAINST 9700.1A
2. NAVSEA SW 270-AA-ORD-010

KEYWORDS: Firing zone; computer vision; machine vision; bore sighting; artificial intelligence.

N98-100 TITLE: Self-Routing in Photonic Packet Switching

OBJECTIVE: To develop a self-routing in photonic packet switching for the phased array radar (PAA).

DESCRIPTION: A photonic system that can quickly compare packet header and router information is highly desirable for the next generation of the phased array radar and optical communications. Presently, the OC-192 of the frame relay of the ATM network is capable of 10 Gbits/sec data rate. In addition to a higher data rate, the Phased Array Antenna (PAA) requires 2D array switching and processing to the antenna elements. Therefore, an all-optical method of packet header comparison with minimal speed bottleneck to allow more than orders of magnitude faster throughput (such as 100 Gbits/sec) is very critical to both optical communication and military applications.
PHASE I: Develop innovative concepts, and provide proof of concept by demonstrating photonic/hybrid method(s) capable of at least 100 Gbits/sec throughput. Provide a photonic/hybrid demonstration device for proof of concept (small scale).
PHASE II: Develop, fabricate, and test a full scale (at least 16 x 16) fast self-routing photonic packet switching system. Provide design disclosure package and test plans, and report test results.
PHASE III: Transition to phased array radar and fiber optic communication system

COMMERCIAL POTENTIAL: Highly diverse communication system applications, including the Internet and Automatic Teller Machine (ATM) Network. Most of current ATM network and the Internet is based on electronic switching/routing that limits the speed significantly, typically to Gbits/sec. A photonic system that can quickly compare packet header and router information is highly desirable for both these applications.

REFERENCES: The fifth annual ARPA symposium on Photonic Systems for Antenna Applications, 1995; Photonics in Switching, vol. 1, AP, 1993

KEY WORDS: All-optical, Packet Switching; ATM; PAA; Fiber; Optical Communication

N98-101 TITLE: Corrosion Prevention and Control for Out Board Submarine System

OBJECTIVE: Develop a composite material based on research and test, to be used in conjunction, either with an existing system or as a stand alone solution, to extend the service life of a launch tube from 18 months to 10 years.

DESCRIPTION: The Navy currently uses a zinc phosphated 1026 steel on a system that is inherently subject to corrosion over time during the mission profile. A cost effective material change is desired to increase the service life of the system from 18 months to a target of 10 years. The final product shall meet the following requirements:

- The composite material must meet the requirements of the Clean Water Act.
- Submarine system certification requirements: (1) explosive shock (2) shipboard vibration (3) ordnance testing
- The composite material shall not increase the weight of the system by more than 1 pound. The candidate material must be capable of meeting the dimensions of a launch tube (Navy drawing 53711-6658880).
- The unit cost of a launch tube that incorporates the material must meet affordability constraints with a goal of cost increase not to exceed 50% of the existing cost.
- The launch tube must survive the launch of a MK 77 MOD 0 Gas Generator without deformation. The launch tube shall not be water soluble and shall be capable of creating water tight seals for the entire service life.

PHASE I: Explore material properties and identify a composite material alternative to the existing system. A thorough Environmental survey shall be provided for the material candidate. Activation energy data for the material shall be provided so that accelerated life test (ALT) models can be developed. A manufacturing process outline is required. The outline shall demonstrate the feasibility of implementing the material into full scale production.

PHASE II: Using the data from phase I along with Navy input, sample coupons shall be fabricated and ALT to simulate 10 equivalent service life years of the system on a Trident Class Submarine. The sample coupons shall consist of the material identified in phase I. ALT data shall quantify, in terms of a dimensioned profile, the average effect of corrosion on a specific section of the sample coupon. A strength prediction on the profiled section shall be made using Finite Element Analysis, given a specific impulse load. Full scale prototype launch tubes shall be fabricated using the candidate material. The prototype launch tubes shall be used for explosive shock, vibration, ordnance launch, and sea trial testing.

PHASE III: An acceptable candidate material, once successfully demonstrated, shall be implemented into full scale production via transition to PMS415.

COMMERCIAL POTENTIAL: The material technology obtained will have widespread use in any commercial sea application. Target markets would include the oil, transportation, and recreation industry where there is a need for high performance and service life extension of components on sea rigs and vessels.

REFERENCES:
1. Handbook of Corrosion Data, ASM International, OH, 1990, Library of Congress ISBN-87170-361-0
2. Corrosion Resistance Tables, Metals, Nonmetals, Coatings, Mortars, Plastics, Elastomers, Linings, and Fabrics, Third Edition, Marcel Decker Inc, NY, 1991, Library of Congress ISBN: 0-8247-8372-7 and ISBN: 0-8247-8373-5.
3. Handbook of Plastics, Elastomers, and Composites, Third Edition, McGraw Hill, U.S.,1996, Library of Congress ISBN 0-07-026693-X

KEYWORDS: composite, environmental survey, accelerated life test, dimensional profile, finite element analysis

N98-102 TITLE: Monopropellant Fuels

OBJECTIVE: Develop an improved liquid monopropellant for torpedoes and other unmanned underwater vehicles.

DESCRIPTION: The Navy currently uses monopropellants in both lightweight and heavyweight torpedoes. The monopropellants contain a homogeneous blend of both fuel and oxidizer to reduce complexity and the need to carry along oxygen. Current monopropellants are harsh on torpedo propulsion hardware and produce a costly waste stream. The goal of this effort is an improved monopropellant that meets or exceeds current performance capabilities, meets Navy defined safety criteria and results in no harmful/toxic exhaust products.

The Navy's primary monopropellant, know as OTTO Fuel II, uses a nitrated alcohol as the energetic consituent. The propellant's decomposition yields approximately 1,100 BTUs per pound (11,275 BTUs per gallon) at a flame temperature of approximately 2300–F. New propellants must be backward compatible in systems that currently use OTTO Fuel II. Energy content, flame temperature, and material compatitibilty are the more significant attributes that must be retained. The propellant is described in Technical Manual for OTTO FUEL II. Any new propellant must pass insensitive munitions testing as described in MIL-STD-2105, Hazard Assessment Tests for Non-nuclear Munitions. Pertinent excerpts of both documents can be made available.

PHASE I: Establish the feasibility of candidate propellants that react/decompose at stoichiometric conditions with no harmful/toxic exhaust products.

PHASE II: Synthesize small quantities of candidate propellants and conduct small and full scale testing to demonstrate the reaction of the candidate propellants through safety and combustion testing.
PHASE III: Design processes to produce the selected fuel on a large scale basis and transition the selected fuel into the Navy lightweight and heavyweight torpedo systems.

COMMERCIAL POTENTIAL: The development of this fuel should have direct application to use in automobile air bags, very high altitude aircraft, space shuttle APU and for emergency power in oxygen limited space applications (e.g., underground mines, submarines, etc.) and any other gas generator applications.

KEY WORDS: liquid monopropellants; liquid fuels; liquid oxidizers; torpedo propellants; gun propellants; torpedo propulsion

N98-103 TITLE: Universal Acoustic Sensors for Acoustic Sonar Arrays

OBJECTIVE: Develop an affordable universal acoustic sensor for acoustic towed line arrays and/or conformal hull mounted sonar arrays.

DESCRIPTION: The goal of this effort is to decrease the cost of acoustic towed line arrays and conformal arrays. Decreasing the number of unique component types for acoustic arrays will allow volume production of sensors. The universal acoustic sensor should be omnidirectional and cover the primary hull mounted transmit frequency and passive low frequency ranges. Universal means that a single sensor design would cover several octaves of frequency. An alternative would be to have a family of sensors fabricated from the same component set which would allow a major sensor (and array) cost reduction. The sensor may incorporate programmable telemetry that would be fabricated as an integral part of the sensor. For example, the sensor could allow summation of its individual mid-frequency acoustic elements to form area averaging lower frequency acoustic sensors. The low frequency sensors could be formed by remotely selecting 2, 4, 8 etc. multiples of the single element sensors to achieve nested towed array apertures. The sensor may be one time programmable at the acoustic channel level and may include the associated telemetry. The sensor shall allow operation below sea state 0 and have a large dynamic range to prevent acoustic signal overload. The developmental sensor(s) should have a diameter of 1/2 inch or less. It is desirable to design the sensor to interface to the NUWC developed Monolithic Analog Signal Conditioner (MASC) Integrated Circuit. The input noise level for the MASC is approximately -160 dB re uPA/Hz. The MASC input capacitance is about 20 picofarad. It is desirable to have a sensor with a specific gravity close 1. The sensor, when installed in a towed array, will be reeled on a 30" diameter drum. The sensor should have a survival pressure of at least 2500 psi and operate over a pressure range from 0 to 1000 psi. It should operate over all ocean temperatures. A production sensor cost of under $50 each is desired when procured in quantities of 5000 sensors. Additional sensor cost may be incurred if the cost increase is offset by a reduction in telemetry component costs. The sensor should be a key enabling technology for affordable submarine and surface ship towed arrays such as TB-29A, SURTASS, and MFTA.

PHASE I: Develop concept definition, architecture, specification, description, and program plan for a prototype universal acoustic sensor. Develop a preliminary sensor design that will used to demonstrate the universal sensor and why it will be affordable.

PHASE II: Develop and Fabricate Sensor Prototypes and for acoustic test demonstration compatibility with existing Navy towed array assets such as TB-29A and TARS acoustic test array modules for acoustic testing is desirable. Demonstration of affordable cost basis is also essential. The NAVY may construct and test a towed array test module using the sensors.

PHASE III: Transition to towed and conformal array programs. A demonstration array for a Navy towed array or conformal array may be developed and constructed using preproduction quantities of these sensors.

COMMERCIAL POTENTIAL: Acoustic arrays used in oceanographic, hydrographic, and oil exploration applications. Potential markets for spinoffs from the approach include telecommunications, BISDN, and related developments.

KEY WORDS: Sensors; sonar; towed acoustic arrays; conformal acoustic arrays; BISDN communication links

N98-104 TITLE: Embedded Intelligent Tutoring Systems

OBJECTIVE: Develop embedded intelligent tutoring software within the Tactical Control Program (TCP)

DESCRIPTION: The Tactical Control Program (TCP) develops run time applications for transition to combat systems on submarines and surface ships. Reduced staffing initiatives and the movement of training away from shore-based facilities mandate the use of embedded training facilities in shipboard environments. Intelligent tutoring systems can provide extremely powerful learning experiences, and can simultaneously address skill and knowledge training, real-time performance assessment, and just-in-time training. Innovative intelligent tutoring requires that the tutoring adapt to the skill level of the operator being trained and to the state of the whole system which the operator is part of--in this case, combat system tactical readiness. Future combat system automation requires a vehicle which monitors system/operator performance levels and provides real-time training requirements at the system level and coaching at the operator level.
PHASE I. Identify the metrics and approach for readiness/training/skill assessment in real time and at the end of a watch and provide a proof of concept for an embedded intelligent tutor.
PHASE II . Implement the embedding strategy described in Phase I. Using TCP architecture/conventions and JMCIS/DII standards, develop embedded training assessment metrics and tutoring strategy/methods. For selected TCP products, build prototype training products.
PHASE III The prototype products, if acceptable, should transition directly into TCP. After that, the TCP product family has many other modules / segments which will need complementary training components.

COMMERCIAL POTENTIAL: Any software product either for the government or for the commercial sector needs directions and training. "HELP" functionality built into most software is usually focused on directions for use of that software. "TRAINING" buttons on software packages would be the natural extension of this. With real software training built into software packages, greater acceptance and fully use can be achieved. The entire "shrink-wrapped" software industry could benefit if embedded training architecture and module building were made uniform through a embedded training system which would ease training authoring and facilitate software use.

KEY WORDS: Embedded training, tutoring systems, decision aids, TCP

N98-105 TITLE: Tunable Vibration Absorber for Small, Underwater Vehicles

OBJECTIVE: Provide vibration control technology capable of reducing acoustic radiation from small, underwater vehicles by adaptive-passive noise control techniques.

DESCRIPTION: Hull radiated noise is a strong component of the overall noise spectrum of high speed undersea vehicles. Reducing this noise will make these vehicles difficult to detect. In the low frequency range, the broadband quality of this noise is controlled by longitudinal modes of the hull that efficiently radiate acoustic energy. Adaptive-passive noise control techniques have the potential to effectively reduce the amplitude of vehicle vibration modes that are efficient radiators of acoustic energy. Dynamic absorbers can be used to counteract the vibration amplitudes associated with these modes, but the absorber must adapt to changes in vibration sources and the vehicle's responses to these sources. Additionally, care must be taken to insure that, during the adaptation process, the absorber does not settle onto non-radiating modes of the structure. These non-radiating modes can have frequencies that are very close to the natural frequencies associated with the radiating modes. The technique must be robust so as to adapt to changes in source frequency and to prevent the system from adapting to control acoustically inefficient modes of the hull.
PHASE I: Design and develop a tunable vibration absorber apparatus and sensor package capable of reducing low-frequency torpedo radiated noise due to low-frequency longitudinal modes of the shell. The design shall fit within the confines of a 21" diameter shell.
PHASE II: Fabricate and perform laboratory based, in-water testing of the prototype apparatus designed during phase I. The Navy will provide an appropriately configured torpedo shell for the demonstration experiments and will support the required in-water testing of the prototype unit. Up to three prototype units will be provided to the Navy. The contractor shall support post-test analysis.
PHASE III: Following a successful phase II demonstration, production design and integration of the tunable absorber unit into current and future fleet systems will commence. The entire system will be shock and vibration test qualified. A TBD number of production units shall be fabricated and delivered to the Navy.

COMMERCIAL POTENTIAL: Tunable vibration absorbers will have a commercial value to products requiring vibration reduction under the condition of varying source frequency. Most examples involve variable speed rotating machinery including aerospace and automotive applications.

REFERENCES:
1. M. A. Franchek, M. W. Ryan, and R. J. Bernhard, "Adaptive passive vibration control," Journal of Sound and Vibration (1995) 189(5) 565-585.
2. F. Fahy, Sound and Structural Vibration, Academic Press, London, 1995

KEY WORDS: Vibration absorbers; radiated noise; adaptive noise control; torpedoes; active control; underwater vehicles

N98-106 TITLE: Acoustic Interference Rejection

OBJECTIVE: Develop the capability to detect and adaptively reject own ship's acoustic interference during tracking and localization of wideband acoustic signals in the presence of countermeasures and own ship radiated noise.

DESCRIPTION: Develop signal processing algorithms that will provide acoustic interference look through in shallow water operations. These algorithms shall allow existing acoustic intercept and broadband passive detectors to exploit their intended targets without detecting own ship's deployed countermeasures or own ship radiated noise.

PHASE I: Develop, describe and implement automated "Acoustic Interference Rejection" algorithms for application to an acoustic intercept system (both active and passive). Achieve proof-of-concept within the constraints of platform resources and operational environments.

PHASE II: Complete and test a full prototype implementation of the Phase I algorithms for at sea demonstration and evaluation. Demonstrate feasibility via a rapid prototype system within an existing Navy acoustic intercept system.

PHASE III: Fabricate and deliver additional systems for test and integration into existing US Navy platforms.

COMMERCIAL POTENTIAL: Undersea surveying, mining, oil exploration, and marine biological research

KEY WORDS: interference rejection; acoustic intercept; countermeasures; passive detection; broadband; wideband signals

N98-107 TITLE: SC 21 Smart Product Model (SPM)

OBJECTIVE: To develop and demonstrate through distributed simulation an initial federation of models for a surface warship. This initial federation will be part of the envisioned total ship Smart Product Model (SPM) for SC 21.

DESCRIPTION: The Program Office plans to build a Smart Product Model of the ship. This SBIR will develop a federation of models that will become a part of the total SPM. The SPM is envisioned as a tool for the evaluation of ship concepts throughout the life cycle of the program and to facilitate implementation of Cost As an Independent Variable (CAIV). The SPM must be able to evaluate proposed concepts in the areas of ship and system performance, warfare assessment, cost, manufacturing, test and evaluation, training, future upgrades, and operations. It will also be utilized to evaluate prototype and production equipment and computer programs as part of the T&E program throughout the ship's life cycle. The SPM will include system models for shore, space, air, undersea and other surface based segments.

Definition: A Product Model (PM) is defined as a combination of geometric and non-geometric engineering data which describes the physical and logical configuration of the ship, including elements of the ship's information

architecture and combat systems. A Smart Product Model is defined as a Product Model that has component and system level physical and operational behaviors and environmental data incorporated.
PHASE I: Develop proposed method to demonstrate the SPM concept for a surface warship such as SC 21. This will include development of model selection criteria and process by which to build an initial federation of models.
PHASE II: Build the federation proposed in Phase I and demonstrate its utility in a distributed simulation.
PHASE III: The federation of models that has been built and demonstrated in Phase II will be incorporated into the SC 21 Smart Product Model during Phase III. This technology will also be transitioned to other ship acquisition programs such as CVX.

COMMERCIAL POTENTIAL: A successful development of an SC 21 SPM will make it possible for industry to propose use of their systems/equipment on surface warships and evaluate the performance of their systems in the environment in which the ship will operate without the need for expensive operational demonstrations. Private sector application/dual-use of SPM technology will be the development of the capability in the Defense industry (shipbuilders and Defense contractors) to be better able to diversify and compete in commercial markets on other than Defense products through the use of this technology that will reduce product cost and time to field. In this way, we will be helping to maintain the Defense Industrial Base.

REFERENCES:

1. http://www.dmso.mil
2. http://www.itsi.disa.mil
3. http://sc21.crane.navy.mil
4. http://www.acq-ref.navy.mil
5. http://sbdhost.parl.com

KEY WORDS: Federation; Smart Product Model; Simulation; High Level Architecture (HLA); Simulation Based Design (SBD); Simulation Based Acquisition (SBA)

N98-108 TITLE: Grabber for Ordnance Handling Robot

OBJECTIVE: Develop the end effector for a robot to handle ordnance items such as gun projectiles

DESCRIPTION: Automation of weapon handling is a high priority for the Navy, driven by the need to reduce ship manning and eliminate fatigue as a cause of accidents. For ordnance items that are currently moved by hand, such as gun projectiles, propelling charges, chaff cartridges, and sonobuoys, a grasping robot is the preferred approach. (Specialized packaging that interfaces with a handling system would add substantially to the cost of the ordnance items and consume space.) This topic seeks development of a "hand" for an ordnance handling robot that combines dexterous, adaptable manipulation, fast operating speed, great strength and the ability to maintain repeatable accuracy of a couple of centimeters while being subject to

acceleration rates of up to 30 meters/sec2. The hand must grasp items such as a five-inch projectile (100 lb, 5 inches in diameter, 62 inches long) or 155 mm projectile (200 lbs, 155 mm diameter, 73 inches long). It should be strong enough to maintain control of the projectile as the robot moves it quickly during shock and ship motion.
PHASE I: Develop a design for a robot end effector to handle five-inch projectiles and propelling charges. Optimize the design for strength, stability, long operation life, versatility (able to handle a variety of projectile shapes and sizes), and safety (the robot must work in a magazine). The effector should be able to grab a round from a honeycomb storage tube (accessing the round from the end), from an unstructured stack on a pallet, and from an opened shipping container.
PHASE II: Fabricate the end effector and demonstrate its ability to handle rounds in conditions similar to a shipboard automated magazine. These conditions include shipboard shock, vibration, and ship motion loads, as well as the movement of the handling robot, which will accelerate the end effector at up to 30 meters/sec2
PHASE III: Incorporate the end effector into an automated magazine as part of the Next Generation Naval Gun and Vertical Guns for Advanced Ships (VGAS) program. Develop the end effector for other weapon-handling functions such as Mk 36 decoy loader launching or loading sonobuoys onto aircraft.

COMMERCIAL POTENTIAL: Such end effectors represent a significant increase in robotic capability. Current robots use grabbing actions for small components (a few pounds) but rely on specially made attachments to handle large items weighing hundreds of pounds. One specific application is automated package handling. For example, the US Postal Service recently released an RFP asking for pick-and-place robots and gantry traveling robots to handle mail trays, bags, and packages, weighing up to 250 lbs. Another is materials handling in hazardous environments, such as mines or grain mills, where a lost load becomes a potential spark/ignition source.

REFERENCES:
1. "Automated Ammunition Handling Magazine" Advanced Technology Demonstration Proposal (available from Defense Technical Information Center or the first POC below.)
2. Voss, Dan L., "The Case for Automated Ammunition Magazines and New Guns Modularized with Automated Magazines" presented to the ASNE Conference, Washington DC, March 1997

KEY WORDS: robot; hand; gripper; grabber; end effector; magazine

N98-109 TITLE: Control Approach for Heavy Payload Handling Robots

OBJECTIVE: Develop innovative control approaches for robots handling heavy payloads. Desirable improvements include quicker, more accurate motions, control of forces on the robot structure, reduction in the size, mass, and power requirements of motors and actuators

DESCRIPTION: Increased use of robotics to reduce crew size for future ships requires robots that can handle heavy payloads quickly and accurately. Automated weapons magazines, storerooms, and replenishment-at-sea systems are some specific application areas. In the example of an automated gun magazine, robots would be required to extract projectiles weighing up to 300 lbs from storage cells, move them 30 feet across the magazine, and load them into a feed tray, with positioning accuracy at the centimeter level. This topic seeks improved control theory approaches that will provide this type of payload, speed, and precision using the lightest, most efficient, most operationally flexible and least expensive robot possible.

PHASE I: Develop the theory and synthesis techniques for an improved control theory. Demonstrate its performance in a simulation.
PHASE II: Transfer the control approach to a hardware test bed and show its performance.
PHASE III: Implement the control approach in a military system, such as the magazine for the Next Generation Naval Gun.

COMMERCIAL POTENTIAL: Improved control approaches will have substantial payoffs in all areas of robotics, including production automation, robotic package handling (for example, airline baggage handling, in the Post Office, or at package express companies). Applications in transportation include active suspension, smart skid control, and active cruise control. Because an improved control approach would be essentially, a software change, it could be backfit to existing mechanisms, providing smoother operation, greater precision, and more efficient trajectories.

REFERENCES:
1. Oak Ridge National Laboratory Patent Disclosure "Dextrous Manipulation of Heavy Objects." (Available from Defense Technical Information Center)

KEY WORDS: robotics; control system; precision; automation; magazine

N98-110 TITLE: Rugged, Portable Ground Station for NSFS Targeting

OBJECTIVE: Develop a fire control station that is easily carried by one forward deployed Marine which provides the abilities to monitor or control weapons and surveillance assets launched from ships positioned over the horizon, and to designate targets to those ships and their weapons.

DESCRIPTION: Technology advances in weapon and surveillance systems combined with long range maneuver warfare requirements have created an increasing need for high portability control systems and situation awareness nodes. The Navy is developing very long range weapons to support Marine Corps maneuver units beyond 100 nmi from the ships position, wherein terminal control at the engagement site is feasible. In these maneuver warfare environments, Marines can no longer depend on the classical forms of executing mission objectives. One example is operation with a new targeting and weapon delivery system, the Forward Air Support Munition (FASM). As recently stated by OPNAV staff, however, even a laptop sized computer and control station may not be acceptable for these dismounted maneuver troops. The goal of this project is to define and evaluate a man-portable control station, which includes imagery display, communications and computational facility. The control station must have minimum impact on all forms of mobility, yet permit simple functional operation, in all environments under engaged conditions. This will permit company or possibly smaller sized maneuver units to obtain tactical situation awareness data or neutralize specific objectives which cannot be readily achieved through conventional call-fire methods. This capability does not replace the functions of imagery analysis, storage/retrieval or interface to other command centers - which would be simultaneously implemented in the ship or shore based command centers. The ground station must be able to use tactical communications to provide target coordinates to the firing ship, and then establish communications with incoming targeting assets and weapons to direct and control them and use the information they develop.

PHASE I: Develop design concepts and conduct technical evaluation of man portable systems suited to the mission objectives. Interface with Navy and Marine Corps development organizations to assure compatibility with operational need. Critical issues may be demonstrated through computer simulation or existing hardware experiments.

PHASE II: Develop a detailed design of a tactical system, supported by additional operational requirements and conduct of control structure analysis. Demonstrate the control station with new or existing hardware under a realistic tactical situation. This could be accomplished in conjunction with other weapon system demonstrations, such as those under the Commandant's Warfighting Lab, or by simulated inputs from other virtual reality environments.

PHASE III: Perform additional design and analysis to construct and demonstrate a fully tactical control station that satisfies operational navy/Marine maneuver warfare requirements.

COMMERCIAL POTENTIAL: A portable control station of this type could be employed in numerous fire-fighting, industrial and environmental applications. Examples include police use at complex crash or disaster scenes, and first-response team use at crash scenes or fires, on-site maintenance, and augmented reality for training. Michael Dertouzous, head of MIT's Laboratory for Computer Science, postulates a "body net" to integrate the currently discrete computer and electronic devices carried by people today-cell phones, tape players, organizers, hearing aids, etc. This SBIR topic can apply this paradigm to the tactical information needs of the Marine in the field, and so will establish a definition for the commercial product.

KEY WORDS: Control station; computer; portable; wearable; targeting; network

N98-111 TITLE: NAVARM Naval Range Extender for Army Artillery Shells

OBJECTIVE: Develop technologies which can greatly extend the range of present and future Army artillery shells through aerodynamic lift and enable their use in future Navy gun systems.

DESCRIPTION: Present and future Army 155 mm artillery shells have been and will be produced in large numbers at low cost. These low costs are essential for Navy gun launched projectiles as well, but the Army shells have ranges which are much too short for Naval fire support applications. Advanced technologies are needed to extended the range of the Army shells while maintaining low cost. Low cost GPS/IMU guidance and navigation systems are already being developed by the Navy for future projectiles. Innovative aerodynamic lifting surface, control, and actuation technologies are desired to combine with these GPS/IMU systems to enable Army shells to achieve long ranges through employment of aerodynamic lift. These new technologies must be configured to be compatible with existing and future Army spin stabilized 155 mm shells, and with future high performance, smooth bore Navy guns in 155 mm or larger bore sizes.
PHASE I: Develop concepts (eg: deployable lifting surfaces) to greatly extend the range of existing and future low cost 155 mm Army shells when used in future high performance Naval guns.
PHASE II: Develop and test prototype components to determine performance and compatibility with Army shells and advanced Naval guns.
PHASE III: Fabricate and test advanced prototype components in full scale flight to validate their performance in greatly extending Army shell range in advanced Naval guns.

COMMERCIAL POTENTIAL: The low cost, rugged actuation and control systems developed in this effort could be utilized in air handling, heating, and air conditioning equipment, forced-air blowers in incinerators, coal- and oil-fired generators, and other industrial plants, and to improve the reliability, safety, and cost of general aviation light aircraft autopilot systems.

REFERENCES: FY96 Competent Munition ATD awarded to Draper Labs, which tightly integrates a micro-miniature Inertial system and a Global position system to form a very low cost navigation for gun projectiles.

KEY WORDS: aerodynamic lifting surface; stability flight control; compact efficient actuators

N98-112 TITLE: Small, Rugged Internal Combustion Engine

OBJECTIVE: Develop a small (5 lb), rugged (gun-launchable), internal combustion engine that runs on a shipboard-safe heavy fuel (high flash point), for application to aircraft propulsion and electric power generation.

DESCRIPTION: Applications in expendable sensors and aircraft, unattended radio stations, and similar portable applications require a compact internal combustion engine. This engine should be exceptionally rugged-suitable for launch from guns and missiles and for delivery by airdrop. Operation after 9000 g setback acceleration is required. The engine must be powered by a shipboard-safe "heavy" fuel (that is, with a high flash point, such as JP-5, JP-8, or JP-11). It should be manufacturable in a low-cost, expendable version (12-hour operating life) and a more durable version for longer operating life. Other specifications are: fit in a 5-inch diameter cylinder, length not to exceed 18 inches, output of 4 brake horsepower, and fuel consumption not to exceed 1 gallon per hour at 70% power, and weight not to exceed 5 lbs.
PHASE I: Design the engine. Show that the design will be suitable for surviving 9000 g setback acceleration
PHASE II: Fabricate a prototype engine. Characterize its performance and demonstrate its acceleration hardness.
PHASE III: The first transition opportunity for this engine is in the Forward Air Support Munition, a gun-launched surveillance, targeting, and precision delivery air vehicle. FASM is being developed by PMS 429, the Naval Surface Fire Support program office.

COMMERCIAL POTENTIAL: An engine this size will bridge the gap in portable energy sources that exists between portable generators in the 50 lb class and 5-lb battery packs. Operation on a high flash point fuel, rather than gasoline, will reduce the hazard associated with gasoline, making the engine suitable for standby generator applications in homes and other buildings where gasoline storage is undesirable. (That is, this engine could be installed in the basement, rather than in a garage or other outbuilding.)

KEY WORDS: Engine; Power; Propulsion; Generator; Internal Combustion; Heavy Fuel

N98-113 TITLE: Robotics - Develop Manipulators To Handle Various Types of Manufacturing Processes

OBJECTIVE: Develop robotic manipulators and controllers to provide coordinated uniform manufacturing processes, plus sensors and software for hands-off operations independent of the fabrication process. This objective is unique because, unlike earlier robotic efforts such as PAWS, it separates the delivery system from the application and. It focuses on the development of a manipulator that can be adaptableed to a broad number of similar applications but which may have very different degrees of complexity. For example, welding, fitting, gluing and grinding require contact with the host surface, while cleaning, blasting, painting and inspection do not require contact.

DESCRIPTION: Develop gantry, articulated arm, and portable robotic manipulators and controllers, including sensors and software for hands-off operations, to coordinate the operation various types of manufacturing processes including cutting, fitting, welding, cleaning, blasting, painting,

gluing, and inspection. Development of coordinated system manipulators and redundant axis (i.e. more than six axis) controllers for robotically controlled processes will facilitate large scale production of advanced shipbuilding initiatives such as stainless steel advanced double hull concept and composite topside structures.
PHASE I: Develop a capability to manufacture and integrate robotic manipulators and their controllers, to provide hands-off production processes independent of the fabrication process (i.e. welding, grinding, painting, gluing, inspecting), unlike PAWS which is specific to welding only.
PHASE II: Implement the capability into a prototype and conduct proof of concept testing.
PHASE III: Demonstrate production capability; scale up from prototype to full rate production to meet needs of advanced shipbuilding initiatives.

KEY WORDS: Robotics; Manipulators; Controllers; Articulated; Gantry; Software; Sensors

N98-114 TITLE: Advanced Technologies Leading to Condition Based Maintenance

OBJECTIVE: Define innovative concepts utilizing advanced technologies, such as prognostics, to translate the Navy's Schedule Based Maintenance system into a system in which we conduct all preventative maintenance based on the actual health of that individual equipment.

DESCRIPTION: The highest equipment failure rate can be attributed to starting and stopping equipment, and equipment operation after improper maintenance has been conducted. To reduce the financial burden of these failures, we can feasibly reduce an equipment's required maintenance by accurate predictive diagnostics and conducting maintenance when the equipment dictates the requirement, not when the maintenance is due on a cyclic schedule. Development of these predictive concepts will reduce the equipment's mean time between failure. This is due to the fact that you will be able to take that gear off line prior to failure. By repairing that equipment at its first indication of casualty symptoms, the repair costs are dramatically decreased. New technology in this field could also reduce the Intermediate and Depot level work packages required during availability periods due to the knowledge of an equipment's actual health thus deferring equipment overhauls until absolutely necessary.
PHASE I: Develop a design, structure, and procedures to define and apply condition-based maintenance technology to shipboard equipments, sets, and systems. Identify the procedures for which to diagnose equipment problems and apply then in an marine environment, in an effective and efficient manner. Assess current technology and apply it naval environments. Demonstrate the outlined technology and prototype equipment with a specific system in a shipboard application.
PHASE II: Demonstrate this technology on a total ship basis, to develop the concept's capability and increase the ship's actual material readiness after complete incorporation.

PHASE III: Develop retrofit plans to apply the new technology to all classes of ships.

COMMERCIAL POTENTIAL: Any commercial industry, both marine or other engineering applications, could benefit utilizing the described technology. Financial relief from decreasing repair and maintenance budgets should be a generic gain.

REFERENCES: General articles on Condition Based Maintenance, Naval/Marine Industry Magazines

KEY WORDS: Condition Based Maintenance; Prognostics; Advanced Diagnostics, Material Readiness

N98-115 TITLE: COTS Approach to Information Security

OBJECTIVE: The advent of COTS systems has established a moving target for information security. COTS products and have been designed with less concern over data integrity issues in or outbound information. There is a need to minimize the effort required to maintain good security practices, but also balancing the requirements of information security for military combat systems.

DESCRIPTION: With the increasing usage of COTS, especially in the operating system and device driver domain, military applications have become increasingly more vulnerable to both advertent and inadvertent intrusion. A standardized tailoring of these and other COTS elements would help both the developer and the accreditor when developing embedded military systems. The introduction of commercial networking solutions has further opened the door for security breakdown. Strategies which allow the use of networks, but minimize their vulnerability are needed. Software and hardware aids, both embedded and external, are needed to assist the development and deployment of military systems.
PHASE I: Survey the current security accreditation process. Generate tailorings which support the broad range of commercial operating systems and networking solutions. Demonstrate compliance with the accreditation requirements.
PHASE II: Prototype the process and demonstrate on an actual combat system. Evolve the Phase I work to handle other facets of security including mult-level security issues.
PHASE III: Develop a seamless process and tool set for information security using available commercial products wherever possible.

COMMERCIAL POTENTIAL: With the explosion of the internet and electronic commerce, information security methods have become obsolete. Methods for information security which are application non-specific will represent significant risk reduction in the commercial environments.

KEY WORDS: Infosec, Multilevel security, network security

N98-116 TITLE: Compact Sensor for Measuring Large Strains on the Surface of Elastomers

OBJECTIVE: Enable the measurement of large strains (up to 150%) on the surface of an elastomer (e.g. natural rubber) while the material is submerged in water.

DESCRIPTION: The technology to accumulate and store significant levels of strain energy in an elastomer has been demonstrated by inflation of disks, spheres, etc. The need to accurately measure strains associated with an inflated elastomer is of critical importance to product development, proof testing, and operational condition monitoring. This effort would use existing and new technology to design and fabricate a suitable compact strain sensor for the above application. Ancillary electronics (e.g. amplifiers, signal conditioners) that are not commercially available shall also be considered as part of this effort.
Existing devices for measuring large strains on elastomers include the laser extensometer that is typically used for laboratory material testing of flat samples subjected to homogeneous strains. This type of device is not well suited for underwater applications on curved surfaces subjected to inhomogeneous strains. Birefringent methods that involve coating the part can be used in the large strain regime but require photographing the part in a strained state while underwater. Foil and semiconductor strain gages are not applicable due to small strain limitations (typically <30%). A compact sensor capable of accurately resolving large strains on the surface of an elastomer while submerged in seawater and deformed requires innovative implementation of existing and new technology.
PHASE I: Develop innovative concept design(s) in sufficient detail to assess sensor performance, size, and cost of a manufactured device.
PHASE II: Fabricate prototype sensors and conduct in-situ evaluations under actual or simulated operational conditions. Optimize performance and accuracy while minimizing the sensor size.
PHASE III: Manufacture production sensor packages including operating instructions and specifications.

COMMERCIAL POTENTIAL: The use of elastomers and rubber materials in industry and consumer products is ubiquitous. Large strain measurement capabilities will not be limited to underwater measurements. This will enable manufactures to routinely test strain instrumented prototypes during product development.

REFERENCES:
1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, 3rd ed., McGraw-Hill, 1991.
2. The Journal of Strain Analysis for Engineering Design, Mechanical Engineering Publications, Ltd., New York, 1976-present. ISSN: 0309-3247

KEY WORDS: strain; sensor; elastomer; transducer; strain gage; rubber

N98-117 TITLE: Combat System Testing & System Integrity Assessment Tools

OBJECTIVE: Develop an innovative low cost automated approach for regression testing & monitoring change control of COTS hardware and software components and associated test concepts/methods which validate use of parts procured for technology refresh, spares and maintenance of the system.

DESCRIPTION: The incorporation of commercial off the shelf (COTS) Hardware and Software in the shipboard environment has meant low cost/high technology systems are now being deployed. The ability of COTS systems to maintain low cost/high is driven by rapid change in COTS technology. This introduces a significant new issue of tracking and validating changes to support the maintenance of these COTS systems. Traditionally all parts were tracked at the piece part level and any changes were completely tested via hot Box testing in the actual system environment. Due to the number of changes that will occur in COTS hardware and software a new methodology of tracking and testing is required to allow for procuring spare parts affordable, and adequate to ensure continued system integrity.
PHASE I: Identify various COTS products to determine the expected rate of engineering change and develop a model or technique which could be used to predict these changes for various classes or types of COTS products. Provide a methodology to be used to monitor changes based on the prediction tool. Using a select group of COTS products validate the prediction tool and monitoring techniques. Provide a technique or method which could be used to determine what change class would require testing and a method to test or validate these changes in the system environment. Perform a sample life cycle cost analysis of these new techniques vs the traditional approach of monitoring all parts/changes and Hot Box testing to demonstrate savings.
PHASE II: Continue to validate the prediction model and monitoring techniques with a larger set of COTS products. Develop and test the methodology defined in phase I which can be used to evaluate the compatibility of a changed asset in the system environment.
PHASE III: Prepare final documentation and implementation of the prediction tool, change monitoring requirements and test validation techniques for deployment and use in multiple system applications and platforms.

COMMERCIAL POTENTIAL: This system could be applied in any work environment where large scale COTS hardware and software systems are used and the need for normal system maintenance involving spares or repair assets are required.

KEY WORDS: maintenance, spares, configuration, change, COTS technology

N98-118 TITLE: Plasma Antenna For Type 18 Periscope

OBJECTIVE: Develop an antenna using plasma technology that can be mounted on a Type 18 periscope and will receive radar signals in the 1 GHZ to 40 GHZ frequency range.

DESCRIPTION: Plasma theory predicts the possibility of using a plasma as an antenna. Theoretically, a plasma

antenna could be dynamically reconfigured to receive a wide range of frequencies by changing the ion densities rather than the physical length. A Plasma antenna that could be dynamically reconfigured to detect radar signals between 1 GHZ and 40 GHZ would be a valuable asset to a submarine if it could be installed in a periscope. The size of the antenna would be restricted to the space available in the periscope barrel, which is 7 inches in diameter. It is anticipated that the height of such an antenna would not exceed three inches, excluding pressure boundaries and radome.
PHASE I: The Contractor shall prepare a feasibility study to determine how to design a plasma antenna that can be dynamically reconfigured to detect radar signals in the 1 GHZ to 40 GHZ frequency range. The design must meet the space limitations of the periscope. The feasibility study shall include the type of plasma considered, the theoretical gain and receiving pattern of the plasma antenna, and show that the operating environment was considered in the study.
PHASE II: The Contractor shall design the plasma antenna, build and test an Engineering Development Model, and prepare developmental drawings.
PHASE III: The plasma antenna will be installed on a submarine periscope and tested at sea. Mass production of the plasma antenna will be evaluated, as well as reducing the size of the antenna to make it portable. Possible dual-use applications include radar detectors for law enforcement, portable extremely high frequency transmitting and receiving antennas for satellite transmissions, miniature commercial radios.

COMMERCIAL POTENTIAL: While signal transmission is not a part of this design, it is clear that the antenna can transmit as well as receive a signal. It is also anticipated that frequencies much higher and much lower than the stated frequencies will be able to be transmitted or received with similar designs. Since, theoretically, the size of the plasma antenna should be considerably smaller than a metal antenna for the same frequency, there is great commercial potential to devise miniaturized and portable antennas with this technology.

REFERENCES:
1. Roussel-Dupre, R. Miller Radiative Properties of a Plasma Moving across a Magnetic Field Physics of Fluids B 5(4), April 1993
2. America Nucleonics Corporation Plasma Antenna in a Nuclear Environment, prepared for Defense Atomic Support Agency, DSA 1733, 7 October 1965.

KEY WORDS: plasma; antenna; radar; electronic warfare; periscope; extremely high frequency

N98-119 TITLE: Use of Common Object Request Broker Architecture (CORBA) to Control Classified Data Distribution

OBJECTIVE: The objective of this topic is to define and develop a process for use by application programmers to individually tag data with a classification description, and to use this description to regulate data distribution to clients.

DESCRIPTION: CORBA is actually application Middleware. Middleware has become a critical part of software development because companies now take advantage of middleware code to integrate their present and future applications. Low level integration is costly and causes delays in application development. CORBA Interface Design Language (IDL) bridges programming languages, operating systems, networks and object systems with a standard data distribution toolbox.
Use of CORBA to tag data with classification descriptors facilitates multi-level security network implementation. The data paths of these objects can be tracked. Access to specific objects can be granted by matching the classification of objects to the registered classification of the client requesting the objects. This approach could allow systems classified TS/SCI to co-exist on networks with systems classified Secret and lower.

PHASE I: Develop a design of CORBA and its mechanisms of invocation call-paths for methods through the Object Request Broker (ORB) to control data access.

PHASE II: Implement the design of Phase I in a Tactical network (eg: ATM) environment of at least 8 workstations (PC and UNIX mix). A test scenario shall be developed and demonstrated showing how computers are networked together can have access to multiple data object servers with a mixed of multiple classifications assigned to each object on each data server. At least 3 of the computers will have classification restrictions such that they will not have access to all data objects while having access to all of the data servers present on the network. It shall be shown that at no time are these 3 workstations allowed to access objects which are above their classification status.

PHASE III; The method generated in Phase II will be introduced to an existing Navy system for implementation in a multi-level secure environment and tested shipboard.

COMMERCIAL POTENTIAL: This SBIR topic would have potential commercial
application to software developers producing application in environments with multiple user classification and access restrictions.

REFERENCES:
1. http://infosec.nosc.mil/main.html
2. http://www.qds.com/people/apope/ap_corba.html
3. http://www.acl.lanl.gov/CORBA/#DOCS
4.
http://www.dtic.mil/dstp/DSTP/97_dtap/informat/ch030303.htm#
TABLE III-7

KEY WORDS: Security, CORBA, Classification, Information Technology

N98-120 TITLE: Plug and Play Adjunct Processing To Support Rapid Technology Insertion

OBJECTIVE: In order to accelerate the infusion of new algorithms and processing capabilities into the fleet, a platform independent deployment strategy which will enable various organizations to easily install temporary H/W and S/W onto shipboard platforms is needed. The concepts used must balance the freedom of advanced research methods with the discipline needed to deploy technology on a submarine. Tools and methodologies must be developed to provide an adaptable open test platform capable of exploiting the legacy system interfaces and minimizing the cost of technology infusion.

DESCRIPTION: The incorporation of commercial off the shelf Hardware and Software along with industry standard interfaces such as VME, FDDI, Ethernet and POSIX on shipboard platforms have made it possible to now bring real hardware and software onto these platforms and rapidly integrate it with the other system hardware and software resources for real time access to raw element data and display resources. This effort will develop the necessary interface standards and conventions required to allow access to these system resources while providing the required isolation to ensure that performance or functionality is not affected or degraded for required system operations.
PHASE I: Perform a study on what industry standards and conventions for both hardware and software are required to provide access to the necessary raw element data and display resources. Develop a set of system interface requirements and guidelines along with resource utilization limits that will ensure existing system components are not affected when adjunct processing hardware and software is added to the system.
PHASE II: Develop and test a generic controller interface which provides the necessary hardware and software isolation at the same time allowing access to a set of system resources with the requirements and guidelines outlined in phase I. Demonstrate the capability to integrate a set of independent hardware/software assets with the controller which shows access to the system resources without any affects on the main system resources.
PHASE III: Prepare final hardware and software implementation, requirements and resource utilization to allow the controller interface to be used in multiple system applications and platforms.

COMMERCIAL POTENTIAL: This system could be applied in any work environment involving the need for rapid prototype testing of system add-on capabilities in the real environment while ensuring no effect on the main system resource.

KEY WORDS: adjunct, processing, algorithms, advanced, technology

N98-121 TITLE: High Power Switching for MF Active Sonar Aperture Selection

OBJECTIVE: Develop new solid state techniques to switch high power active acoustic transmission pulses and select appropriate transmission apertures in submarine medium frequency spherical array sonar systems.

DESCRIPTION: Current medium frequency active sonar systems use electro-mechanical devices to switch transmission pulses and select transmission apertures. The mechanical switching servos and relays are obsolete and prone to failure. This effort would incorporate new solid state technology and COTS components and equipment to perform the switching functions.

PHASE I: Develop a concept to use new solid state technology and COTS components and equipment to perform the pulse switching functions in the MF active sonar systems. Design and develop circuit schematics and component selections to perform the switching functions. Perform CAE circuit analysis to model and verify system performance.

PHASE II: Develop and fabricate a brass-board prototype unit and perform a proof of concept demonstration of the circuits developed in Phase I.

PHASE III: Based on a successful Phase II effort, develop a prototype model for qualification, test and evaluation, and production purposes, including any required supporting software and documentation, for a MF active sonar transmission pulse switching unit which can be integrated into an existing submarine sonar system.

COMMERCIAL POTENTIAL: This effort has extensive application in commercial acoustics and sonar systems including high-power acoustic power amplifiers and seismic survey equipment associated with oil and gas exploration.

KEY WORDS: sonar; active; submarine; pulse; switching; transmission

N98-122 TITLE: Low Cost COTS Replacement for Versa Module Europe (VME) Chassis Computing Systems

OBJECTIVE: Explore the use of COTS open-system computing architectures as an expandable yet low-cost replacement for legacy VME computing systems in submarine sonar systems.

DESCRIPTION: Many of the sensor, data and display processing, equipment currently under development and production for submarine systems use Versa Module Europe (VME) architecture. The VME architecture, although adequate for current requirements, stepping stone to the next generation of technology. This effort would explore the use of other open-system COTS computing architectures to perform the processing functions of the processing systems at lower life-cycle cost.

PHASE I: Develop a concept to use alternative computing architectures and COTS equipment to perform signal conditioning, signal processing, and display and data transfer processing for submarine sensor systems. Identify system and interfacing requirements. Design and develop system-level block diagrams and equipment selections to perform the processing functions. Perform CAE system analysis to model and verify the computing system performance. Provide system life-cycle cost analysis.

PHASE II: Integrate a brass-board prototype unit and

perform a proof of concept demonstration of the computing system developed in Phase I.
PHASE III: Based on a successful Phase II effort, develop a prototype model for qualification, test and evaluation, and production purposes, including any required supporting software and documentation, for use in existing submarine sensor systems.

COMMERCIAL POTENTIAL: This effort has extensive application in commercial acoustics, sonar, and embedded C3I systems.

KEY WORDS: sonar; COTS; computer; architecture; processing; VME

N98-123 TITLE: Low Cost Hydrophone Manufacturing & Assembly

OBJECTIVE: Develop low cost hydrophone assemblies.

DESCRIPTION: Hydrophone assemblies have continued to keep the costs of acoustic sensors high. These costs are driven by use of conventional ceramics and assembly techniques. New composite ceramics are evolving through continued advances in materials technology, but designs are still such that automation is very difficult. Although some advances have been made in the type of materials used, the higher-level assembly is still very expensive compared to the cost of the basic components ($40 in materials becomes a $1,600 completed assembly). The offeror should be knowledgeable in the art of piezo-electrics and aware of previous efforts in this area, including a familiarity with efforts by ONR, NRL, and NAVSEA prime contractors and suppliers. Offerors should coordinate their approach with, and complement, existing in the field of Hydrophones. Previous efforts have focused on radically new technologies, and provided little benefit to existing systems and ceramics based hydrophone systems. Innovations are possible in the use of new materials, strain relief of components, new connectors, pottted assemblies, new ceramic materials, and use of new spacer or acoustical (dipole) focusing techniques. Technical innovation is necessary in the area of leakage current from the assembly and sensitivity to pressure, which affect manufacturing yield and thereby unit cost.
PHASE I: Identify and develop designs using new ceramic materials, design form-fit replacement assemblies, and assess manufacturability of various designs.
PHASE II: Design, build, and test hydrophone assemblies.
PHASE III: Produce quantities of the system which would be used on various US Navy platforms. Provide repair and spare parts support. Sensor manufacture and assembly has been successfully subcontracted to small business concerns under several towed systems manufacturing contracts.

COMMERCIAL POTENTIAL: Commercial oil exploration systems (towed acoustic streamers).

KEY WORDS: Acoustic sensors; towed arrays; hydrophone; ceramics; cable assemblies;

N98-124 TITLE: Sonar Performance Enhancement in the Littoral Environment

OBJECTIVE: Research the mechanism of surf-generated noise propagation in the littoral environment to better predict the littoral acoustic environment and thereby enhance sonar performance.

DESCRIPTION: Surf-generated noise may propagate seaward within littoral waters to ranges greater than 10km and dominate measured broadband ambient noise levels (Stewart, et al). The submariner can achieve significant tactical advantage with an improved understanding of this natural phenomenon. It is poorly understood what types of shore/near shore environments, i.e. headlands, long sandy beaches, etc., and what range dependent water column, bottom and sub-bottom characteristics both support and attenuate propagation of surf-generated and other coastal noise. The proposed solution to this problem includes 1) selection/development of a suitable acoustic model, 2) research of existing pertinent environmental data sets (bottom, sub-bottom geoacoustic properties and water column properties) to obtain acoustic model inputs, and 3) measurement of specific selected relevant environments not previously studied to obtain model inputs. This solution also involves 4) first running the model to determine shallow water transmission loss behavior of a specific coastal environment and then 5) measuring actual transmission loss in that environment to validate the model. The final pieces of the solution are 6) to assess the contribution to the littoral acoustic menvironment of surf-generated noise and 7) to evaluate and optimize sonar performance in this environment.. Tactical sonar optimization in the littoral environment should be developed as a function of 1) geographical location (unique bottom, sub-bottom, and water column characteristics), 2) frequency, 3) surf type (coastal geography), and 4) competing ambient noise mechanisms (primarily shipping).
PHASE I: Research and develop a suitable preliminary shallow water propagation loss model that takes into account water column acoustic and bottom/sub-bottom geoacoustic properties that are range dependent from coast seaward as well as longshore. Prepare and submit for Government acceptance a three part data measurement plan to first obtain range dependent water column acoustic and bottom/sub-bottom geoacoustic properties for coastal environments; second to measure propagation loss in the shallow water environment and validate the shallow water propagation loss model; and third to include measurement of the surf-generated noise contribution to the ambient noise field in the chosen environment in preparation for assessing and optimizing sonar performance.
PHASE II: Collect and then analyze the environmental data described in Phase I, from unclassified coastal environments with prominent headlands and bays with deep water seaward, such as the California or Oregon coast, and those with more linear shorelines and a more gentle shelf slope such as the North Carolina coast. Other more tactically important areas could be analyzed, however, the analysis of existing data for such areas and collection and analysis of new data for

such areas may require a security clearance. Include measurement of actual transmission loss in the environment studied to validate the acoustic model, and collect surf noise data using a sonar system of interest.
PHASE III: Evaluate and optimize sonar performance in light of surf noise and other ambient noise effects in the environment studied and determine how the acoustic model can then be used to predict sonar performance given geographical location (bottom, sub-bottom, and water column characteristics), frequency, surf type (coastal geography), and competing ambient noise mechanisms (primarily shipping).

COMMERCIAL POTENTIAL: Recently, the impact of man-made noise sources near shore on ocean fauna has caused great controversy, but no background near-shore noise measurements or shallow water acoustic models existed to support or refute contending arguments. The proposed research would be a great value to both the marine biologist and to global warming programs which rely on a detailed understanding of acoustic energy propagation throughout the ocean environment.

REFERENCES:
1. Stewart, CDR M., Dr. O. B. Wilson, Dr. J. H. Wilson, and Dr. R. Bourke. Shallow Water Ambient Noise Caused by Breaking Waves in the Surf Zone. December 1994

KEY WORDS: acoustics; ambient noise; littoral; sensors; shallow water; sonar

N98-125 TITLE: Optimized Laser Scanning Doppler Vibrometer for Measurements on Rotating Propellers in Water

OBJECTIVE: Develop a laser scanning vibrometer capable of accurately measuring full field vibration patterns point by point field at many locations on propeller blades operating in water.

DESCRIPTION: Whereas measurements of this type have been reported by a number of investigators, the accuracy has been limited by the numerous error mechanisms which cause pseudo vibrations. Most typically measurements on the rotating components are obtained by tracking a particular fixed point using scanning laser 1,2. The pseudo vibration generating mechanisms include: non-coincidence of the rotational axis of the propeller with the measuring laser beam; pseudo signal corresponding to apparent once per revolution rotation of the propeller blade with respect to the laser beam, and errors introduced by laser transmission through observation windows. What is sought is a methodology and a device which overcomes these error mechanisms, thereby providing accurate quantitative measurements of the propeller vibrations.
PHASE I: Demonstrate system for accurately measuring point to point vibrations of a rotating propeller in water. Line of sight measurements correctable to out of plane vibration are acceptable. System should be capable of measuring vibration velocity levels smaller than one micrometer/sec for frequencies up to 10 KHz for rotational speeds up to 600 RPM.

PHASE II: Develop prototype system for measurements on propellers in water tunnel as well as for underway ships and small and large scale ship models.
PHASE III: Configure system into portable, computer controlled device with the necessary post processing and imaging outputs required for both commercial and military applications.

COMMERCIAL POTENTIAL: There is an industrial need for a device which can measure the vibration on both low and high speed turbomachines. Such a device would provide a tool for diagnosing noise generating mechanisms as well as fatigue related effects. Whereas the device sought does not need to operate at very high speeds, the technology developed under this topic could be extended to applications for high speed turbines.

REFERENCES:
1. Bucher I., P. Schmiechen, D.A. Robb, D.J. Ewins. "A laser- based measurement system for measuring the vibration on rotating disks," SPIE Vibration Measurements, Vol. 2358, pp398-408. (1994)
2. Castellini, P. And C. Santolini, "Vibration measurements on blades of naval propellers rotating in water," Proceedings of the Second International Conference on Vibration Measurements by Laser Techniques," SPIE Vol. 2868, pp186-194, (1996)

KEY WORDS: Laser; Doppler; Vibrometer; LDV; propeller measurements; rotating

N98-126 TITLE: Combat Systems COTS System Administration

OBJECTIVE: Facilitate on-board, real-time maintenance, fault diagnosis and repair, of COTS Combat System networks. Provide an interactive tool for complex problems like bringing replacement components back online.

DESCRIPTION: Performance Support Systems combine diagnostics, technical data, and a dynamic knowledge base into a single product. As the Navy moves to a client/server system architecture for combat systems, system maintenance and administration will become increasingly technical. The commercially available tools available today to assist the sailor maintain client/server networks fall short of providing solutions to system problems. These tools will identify when a component of the network drops off-line, but provide no guidance on the corrective action, or the cause of the fault. This topic calls for the research and development of a system administration tool that combines diagnostics, technical data, such as the Interactive Electronic Technical Manual (IETM), training curricula, such as Interactive Courseware (ICW), and a dynamic knowledge base. This would allow the sailor to diagnose a system component fault or failure, determine the appropriate procedure to correct the problem, and determine how to ensure the problem does not occur again. Having an interactive system maintenance and troubleshooting tool will

yield minimum down time of mission-critical components and potentially reduce training and manning.
PHASE I: Design Concept of a Performance Support System for System Administration of Navy ship-board combat systems. The concept must demonstrate how the diagnostic procedure would invoke the technical and training documentation, and how fault/failure information would be captured.
PHASE II: Prototype and test the Performance Support System for System Administration on a mature system in a laboratory environment. Demonstrate the systems use of IETM, ICW, and the dynamic knowledge base. Provide hooks for future growth and system enhancements. Refine system based on operator feedback.
PHASE III: Integrate the Performance Support System for System Administration into the NSSN Non-Propulsion Electronics System (NPES) network architecture. The product shall be fully integrated with subsystem IETMs, ICW, and be fully capable of recording and learning from system faults/failures.

COMMERCIAL POTENTIAL: Most commercially available system management tools will identify when a component drops off of the network. This product can potentially take these tools one step forward by identifying the cause of the failure, and the procedure to restore the component. This application is not military unique, and could be applied to any commercial network that has adequate technical documentation.

KEY WORDS: System administration, automated, diagnostics, manning reduction, Performance Support Systems

N98-127 TITLE: Next Generation Combat System Display Concepts

OBJECTIVE: Presentation of sonar information can be improved significantly by exploiting multimedia and signal processing technology in a manner that provides a more intuitive look and feel to the operator. Improvements to traditional methods must stimulate real time, spatial-visual and audio responses. A virtual reality approach to the sonar system sensor data can greatly improve the fleet's effectiveness while reducing training requirements.

DESCRIPTION: While the introduction of Commercial Off The Shelf (COTS) systems have advanced the signal processing capabilities of submarine platforms, operator controls and displays have not changed significantly with this new technological enhancement. While the sonar operator will benefit from more information available to him, managing this information has become a formidable challenge. In high contact density scenarios, operators can easily become overloaded which can result in missed detections at nominal detection ranges. Innovative data presentation techniques that provide intuitive and clear representations of the acoustic data are needed to reduce information overload to the operators. A three-dimensional sonar detection display could provide this information reduction; additional innovations are sought to accomplish this goal. Solutions should adhere to the X-windows MOTIF Graphical User

Interface Standard and/or OpenGL.

PHASE I: Develop innovative Sonar Data Presentation concept(s) founded on the GUI MOTIF Standard and the control and display methodologies of available Submarine Sonars. The performance capabilities of the innovative display must be superior to existing Sonar Data Presentations, permitting the operator to achieve better identification of targets and target tracks in less time and with less fatigue.
PHASE II: Design and fabricate a 'brass-board' prototype, and perform a proof of concept demonstration on selected display candidates developed in Phase I of this effort.
PHASE III: Based upon a successful Phase II effort, develop a prototype model for qualification, test, and evaluation and production purposes, including supporting software and documentation, for a control and display system which can be integrated into an existing submarine sonar system.

COMMERCIAL POTENTIAL: These display techniques can be transferred to other areas of the commercial world in which a simplification of data presentations is required. Some other applications include medical imaging, air traffic control radar systems, and potentially digital photographic image processing.

KEY WORDS: MOTIF; Advanced GUI; Three Dimensional Displays; Data Fusion; Information Reduction;

N98-128 TITLE: Migration of Advanced Development and COTS Applications to Tactical Operating Environments

OBJECTIVE: The objective of this topic is to develop a common operating environment to facilitate the rapid infusion of advanced development and COTS applications into legacy tactical systems.

DESCRIPTION: Because of the strict performance requirements of tactical systems (e.g., real-time processing, reliability, database structures, etc.), legacy tactical systems have relied on unique operating environments, which make the transition of advanced development and COTS products technically challenging and cost prohibitive. A common operating environment, imposed on both advanced development and tactical system developers, will provide standardization of product interfaces and ease the migration of technology into tactical systems.
PHASE I: Define critical technical parameters and define a profile or set of profiles to meet those parameters. At the end of the Phase I, an approach, high level design, and profile with perfromance predictions will be selected for further testing.
PHASE II: A demonstration employing the techniques identified in Phase I using PEO-USW ASTO and COTS products will be performed and measured against the predictions developed in Phase I.
PHASE III: A full system design will be developed, applying the principles generated in the previous phases, to meet tactical requirements.

COMMERCIAL POTENTIAL: Use of a common operating environment will facilitate the infusion of COTS products and open system interfaces into tactical systems, which is of benefit to the commercial hardware manufacturers and software developers..

KEY WORDS: Submarine; COTS; Advanced Development; Software Migration;